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Annealing Glass With the Electric Lehr

Entire Output of California Bottle Factory to Be Annealed by Electricity

By Kenneth M. Henry*

Close control of temperature within very narrow limits through the annealing cycle of the glassware, together with a better quality of output, are the outstanding results of the application of electric heat to glass lehrs by the Illinois Pacific Glass Company at San Francisco.

Early in 1920 we became dissatisfied with the best results obtainable in annealing glass, and our technical staff undertook the complete investigation of existing methods in order to find means for improvement. Inquiry disclosed that local annealing conditions were no worse than, and not very different from, those of most plants throughout the industry. Annealing furnaces, or lehrs were of all sorts of designs, but as the underlying principle employed in all was the same, it was evident that the faulty results were due to that principle rather than to the apparatus used to apply it.

Next it was noted with interest that the development of annealing practice had been the development of the lehr and no serious thought has been given apparently to evolve a theory of the process and thus to improve and perfect the process itself. Manufacturers of glassware had inherited the idea that their ware had to be placed in an oven for annealing, or "tempering" and when the demands of increased production had to be met, they placed moving floors in their ovens to accommodate the output of automatic blowing machines. This increased capacity was accomplished with varying degrees of adroitness, but there was no evidence of any attempt to find out the exact treatment the glass required and to secure the application of that treatment.

Accordingly it was decided to attack the problem in the laboratory, and because glass bottles were the subjects in hand, to find out what a bottle required in order to be annealed properly. Without theoretical digression, it should be explained here that a bottle with its multiplicity of curves and angles, and its variety of thicknesses presents a much more difficult problem than the slab or sheet of glass. Nevertheless, after successive months of continuous work it was learned that all of the supposed vagaries of glassware were obedient to fixed laws and an entirely new method of annealing was evolved. This process, now covered by basic patents, has placed annealing on a truly scientific basis, and has eliminated the "hit-and-miss" operations of former methods.

The success of the new process is due to the close control of the temperature which is effected. As soon as it was discovered how glass becomes uniformly annealed it was evident that it would never be feasible to secure results by merely applying heat, however carefully measured and controlled, at one point in the annealing course and then leaving to chance and varying conditions the further oscillations of the temperature back to ordinary level. The laboratory work proved conclusively that true annealing only results from following a time-temperature curve that has been determined scientifically. The next step—to determine how wide a divergence might be made from this curve without harmful results disclosed that the glass would not tolerate a departure of more than 5 deg. F. To maintain such a curve in laboratory apparatus is not difficult, but to reproduce the same conditions on a commercial scale and in a reliable and constant manner is quite another matter. In other words, the laboratory furnished the correct annealing principle, but it still remained to secure a lehr that would apply this principle to practice.

To the Editor:

Our Board of Directors . . . . . have come to the conclusion that we owe it to the glass manufacturing industry to make it acquainted with this important forward step in the production of better quality ware and it gives us pleasure to acknowledge that your publication is best suited to give it the desired publicity.

We enclose herewith an article [containing data on actual operating cost] prepared by our Chief Chemist, Mr. Kenneth M. Henry, who is the inventor and patentee of the lehr and we also enclose some photographs which may be used to advantage.

O. Rosenstein, vice president,
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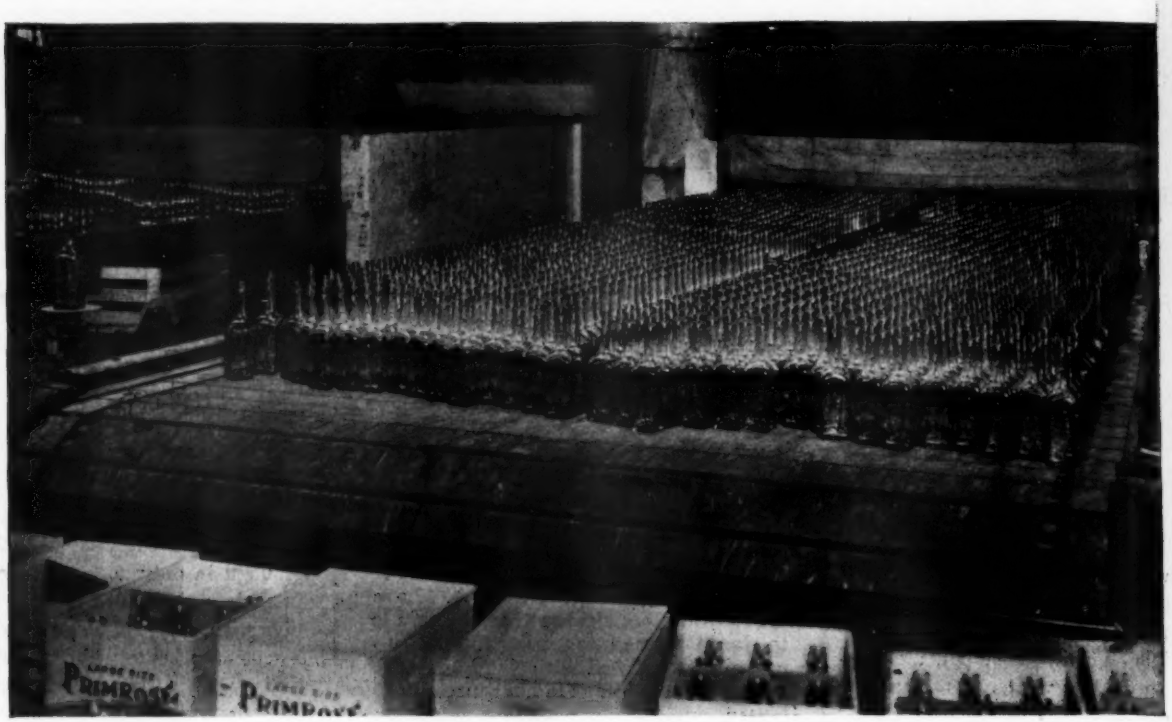


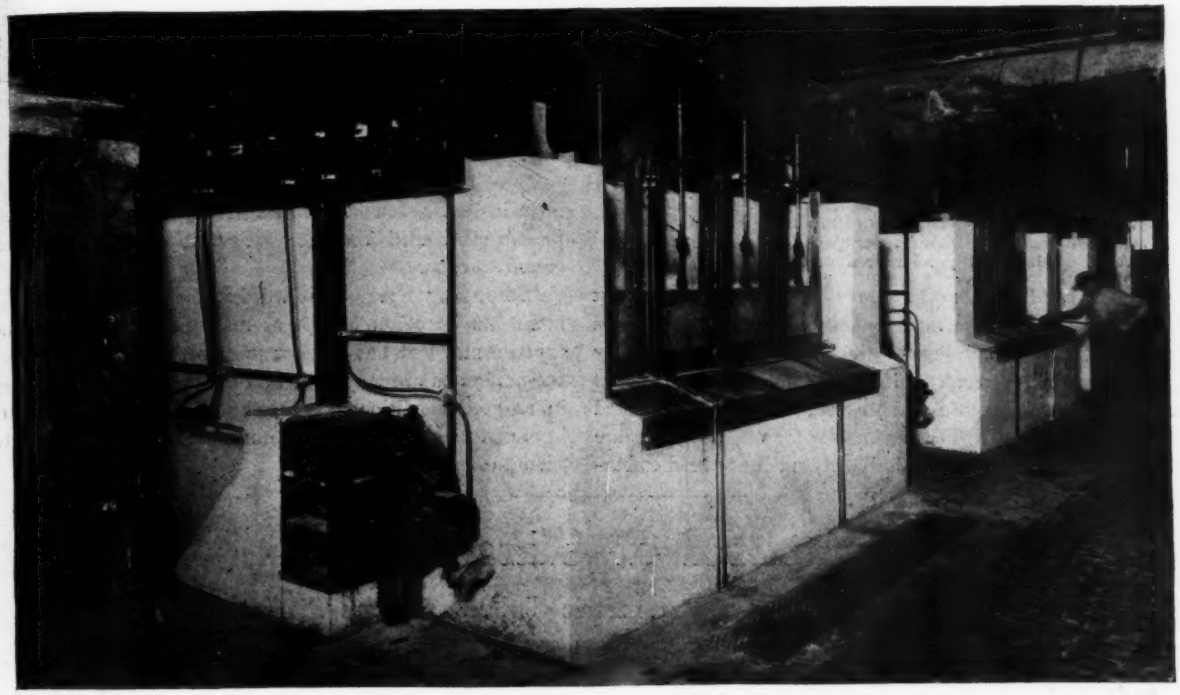
COLD END OF A KENNETH M. HENRY ELECTRIC LEHR
Conveyor belt is made of patented pans designed to prevent entrance of stray curents of air.

In working out the practical problem, it was self-evident that no sustained curve could be secured in any apparatus that only generated heat at one fixed place. It was equally apparent that the heat supply would have to be cut off and renewed at frequent intervals in order to maintain it at constant levels everywhere. The answer therefore was that there must be automatic control operated by the temperatures themselves, and this narrowed the choice down to electricity as the source of heat energy.

FRONT OF HEAT CONTROL BOARD
The lehr temperatures are maintained automatically within five degrees by means of Leeds & Northrup controlling potentiometers

At first the high cost of electricity as a heating agency made its use seem prohibitive. Nevertheless it was decided to design and build an experimental electric lehr, and in cooperation with the engineers of the General Electric Company this was accomplished in 1921. Like all wise experiments this was a modest one although large enough to give commercial results. This first lehr has a continuously moving conveyor 5 ft. wide and 50 ft. long; this was furnished by Stephens-Adamson Company. The nichrome heating units have a connected load of 160 kw. The power is supplied at 220 volts, single phase, 60 cycles. The lehr is divided, by imaginary lines, into three parts—heating, annealing and cooling. The electric units are so distributed on the sides, and top of the lehr in these three departments that they maintain constantly and unvaryingly the temperature curve mapped out in the laboratory. The conveyor, returning from the cold end of the lehr, is preheated on the return by a special set of heating elements. The lehr is insulated adequately with carefully laid Sil-o-cel brick. The heat control is maintained automatically within five degrees by Leeds & Northrup controlling potentiometers and make and break the corresponding contacts on the switchboard.

As far as annealing was concerned the first lehr was a complete success from the very outset. The automatic regulators functioned as planned and kept the temperatures well within the limits laid down. Nothing was left to be desired in the maintenance of the curve on which the annealing depended. The consumption of electric power, while not prohibitive, was in excess of the limit desired for the economic success of the new process. But this has yielded to new studies, and without any alteration of the process or



FRONT VIEW OF A BANK OF THREE LEHRS

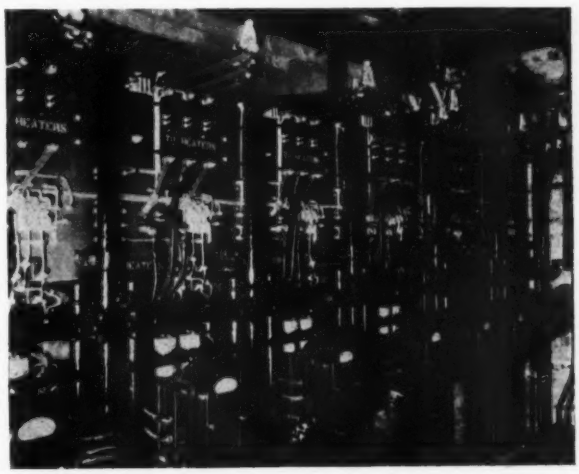
The lehrs are grouped together in banks of three, each bank having its own transformers. The doors are operated by compressed air with a foot-control button.

of its established time-temperature curves, the electric lehr now has been placed on an even keel with others in the matter of economy of operation.

Thus the experimental lehr was a true success and by means of the knowledge gained from it a larger lehr was designed. This second lehr is 8 ft. in width and 55 ft. long with a heating space 25 ft. in length; subsequent lehrs are 9 ft. by 60 ft. which has been found to be a more satisfactory size. The conveyor belt is made up of special patented pans which cut off all stray currents of air. Its automatic doors confine the heat at all times that glassware is not actually passing into it. The doors open by compressed air and operate with a foot-control button; as soon as the operator removes his foot they close automatically. The total connected load in each lehr is 240 kw. with a usual operating load of 80 kw. The lehrs are in continuous operation 24 hours every day in the year. Current is supplied at 220 volts, 3 phase, 60 cycles. The load varies with the amount of glass in the lehr. The current maintains the proper temperature cycle and supplies the radiation losses. All of the apparatus is completely automatic in its operation. Individual meters have been placed on each heating unit so that it is possible to tell if everything has been working satisfactorily over a given period; and if not, to estimate how long the particular unit has been out of operation. One of the advantages of electric heating is the fact that bottles come from the lehr sterilized.

Previously it was necessary to leave bottles in a lehr from 4 to 10 hours while with the electric lehrs this time has been reduced to one hour and thirty-five minutes. The first lehr now has five successors, each of which is doing its work comfortably, perfectly and more cheaply than the old lehrs which it has displaced.

In part this economy is due to the rather low cost of electric current on the Pacific Coast, in part to the total absence of breakage and in part to complete elimination of maintenance expense of the lehr. In order to give the reader an idea of the cost of annealing by this new method actual data are quoted as follows:



REAR VIEW OF CONTROL BOARD

By means of which the heat is kept in control while the lehrs are in operation continuously twenty-four hours a day, every day in the year.

On March 12, 13 and 14 electric lehr No. 4 was annealing export beers of 11½ oz. capacity and 13½ oz. weight. It handled 931 gross (about ¾ of capacity of lehr) and consumed 7.09 K.W.H. per gross. The average cost to us of electric power (we are charged on a graduated scale according to quantity used and we average our cost to all departments in order not to give the lehrs the advantage of the low brackets) is 8 mills and the total annealing cost on this lehr was $5.67 per hundred gross.

On the same dates, electric lehr No. 5 handled champagne-shaped minerals of 6¾ oz. capacity and 10 oz. weight. It handled 1,048 gross (also about ¾ of capacity) and consumed 6.51 K.W.H. per gross. The average cost was therefore $5.21 per hundred gross.

The foregoing examples are considered typical. But by far the greatest advantage derived from the operation of the electric lehrs, lies in the vastly improved quality of the product through uniformly and constantly perfect annealing impossible of accomplishment by any other method heretofore employed. The demand for the very superior ware from these lehrs has been so insistent that it has been embarrassing to complete the change of lehrs as leisurely as we had planned. In fact, we have been compelled to put the electric lehrs into place and into operation as rapidly as the shutdown of glass furnaces would permit, and in a short time this factory will be annealing its entire output in the new way.

Three lehrs are grouped together in a bank which is complete in itself, each bank having its own transformers. At present one bank is complete and two more are in the course of construction.

Incidentally it may be added that the maintenance of the new lehrs is so low in cost as to be negligible. The first experimental lehr has cost for upkeep during the three and one-half years of its operation a total of $25.00 and is today in as good condition as when installed. The other lehrs have cost nothing over an operating period varying from two years to a month.

Control of Glass Tanks

A Discussion of Pyrometric Control of Glass Tanks

By Arthur E. Williams*

Maximum production from a glass tank depends largely upon the delivery of good glass having consistent working conditions day after day to the machines forming the ware. Constancy in quality and workability, of course, requires that a uniform batch mixed in the same way, and containing cullet of practically the same composition and quantity, be delivered to the dog house each day and hour. Assuming this to be the case, correct temperature control is the only other requirement necessary to insure glass of consistent working quality at the machines.

Correct temperature control is considerably more than maintaining the temperature of a single pyrometer placed in a tank at a uniform position. It is the establishing of desirable temperature conditions in the melting end of the tank, in the cooling chamber, and in the working chamber; it is the establishing and maintaining of uniform pressure conditions in these various parts of the tank; and it is having available a tank which may be adjusted to maintain these conditions throughout its life.

A controllable tank shall be constructed with such ample flue spaces, including checkers and chimney, that it responds to damper adjustments at all times, whether it be four months old or one year old. At no time shall its flue space be so constricted that the effect of weather conditions on the draft cannot be corrected. Another desirable feature is the ability of a tank to handle large variations in tonnage without being uneconomical when small tonnages are being melted. This means a tank which has the ability to produce a large quantity of heat and transmit it to the raw batch when large quantities of batch are being melted, but which will not show excessive radiation losses when smaller quantities of batch are being melted.

All temperature control to be correct must be referred to the glass temperature as the standard by which to be governed. In the melting end, the mass of glass must be maintained at a proper and uniform temperature to insure that the chemical reactions and physical activity of refining be maintained at a uniform speed. At the point of exit the glass should be of a uniform viscosity in order to work uniformly, and viscosity is a function of the temperature. There is no question but what the relation of gas temperatures to glass temperatures vary during the life of a tank and even from day to day where draft and pressure conditions are not corrected. Variations in tonnage will also change the relation. There is also a very considerable variation between glass temperatures, wall temperatures, and gas temperatures with different tanks especially where there are slight differences in construction. Conditions from tank to tank may best be duplicated by knowing glass temperatures in the several sections of a tank.

Heat is transmitted to the glass largely by radiation from the furnace walls and from the flame. The amount increasing at a rate equal to about the temperature increase taken to the fourth power. It is important, therefore, that wall and flame temperatures be maintained constant and economical if the flame temperature can be held at a maximum. Equipment for reading both wall temperatures and flame temperatures should therefore be installed in locations carefully selected to give most nearly the information desired. Considering that the amount of heat absorbed from the walls of a melting furnace depends largely upon the amount of cold batch charged, the charging end of the furnace is the one subject to the most variation and where the pyrometer equipment should be installed.

A furnace condition where the cooling effect of large charges of batch may readily be corrected will make for larger melting capacity with limits. If such cooling cannot be compensated for, the rate of melting is considerably reduced and the glass temperatures throughout the furnace are

*Thatcher Manufacturing Company

reduced. Maintaining the wall and flame temperatures up to their proper maximum is important and pyrometer installations should be of considerable aid.

The crown, being the largest proportional radiating surface, is probably the best place for a thermocouple indicating wall temperatures. Its position should be about half way between the end wall and the first port in the center of the crown. With most furnaces operating very slightly above atmospheric pressure the flame will be below this point and the temperature indicated will be that of the refractory surfaces.

Measuring flame temperatures is a more difficult problem as the flame cannot very well be reached with a thermocouple at the point where its temperature is probably a maximum. Temperatures taken with an optical pyrometer give a fair idea of the flame temperature but such an instrument is not convenient to a furnace operator. Readings taken in the port openings or just at one side of the port near the bottom, give temperatures bearing a fairly definite relation to the flame temperature. The relation may be determined occasionally by use of the optical pyrometer. The temperature desired being that when the flame is entering the port rather than when leaving.

The glass temperature in the melting end presents the most difficult problem as they may best be taken by immersion of the thermo-element in the glass and the life of any refractories available to date is very short in the melting end. The optical pyrometer does not give actual glass temperatures. Conditions of reflection on the surfaces of different tanks shown seem to cause rather wide variations in temperature readings for the same apparent condition of operation. Two methods for taking this temperature may be used to advantage. One is the use of a water cooled extention into the tank, having about six inches of bare thermocouple extending beyond the water cooling fixture and immersed in the glass. Whether the cooling effect of the water cooled pipe will give too much error to the reading and what the life of the exposed wire will be I cannot say, but I believe that the surface of the glass would be chilled considerably under the end of the pipe as it would come very close to the surface of the glass.

The second method is to have an inclined hole in the upper structure of the tank just above the flux blocks. This hole should be large enough to take a primary pyrometer protection tube very freely and should be inclined at such an angle that the pyrometer tube will reach the glass about one foot from the inside wall of the furnace. The pyrometer should be so arranged that it may be immersed in the glass until a reading is taken and then be withdrawn into the furnace wall to a point where the temperature is not above 2,300 degrees F. At such a point the glass on the end of the tube will remain soft enough to allow the tube to free immersed when desired. Enough of the tube should be kept hot to allow repeated immersion without taking much time in heating up the tube to avoid cracking. Glass temperatures may be taken about six times a day to check the other temperature conditions of the tank. The position of this thermocouple in the glass seems best in the middle of the tank or between the second and third ports. Reactions will have about completed themselves at this point so that the glass is in the condition of being melted but not fined. Maintaining a mass of glass at a proper temperature at this point continuously, should assure uniform conditions at the working end. The melting capacity of a tank has been reached when the cooling effect of melting is such that the proper temperature cannot be maintained at the location suggested above.

Glass should also be maintained at a uniform and definitely established temperature in the fining or cooling chamber of the tank. This temperature depends upon the method of working, the temperature desired in the feed and the type of glass being worked. Glasses which set at temperatures higher than the usual soda lime glass must usually be maintained at relatively higher temperatures in the finer.

Controlling the temperature of a finer with the present methods of tank construction is rather difficult, as changing the bridge wall to allow more or less radiant heat to come forward cannot be considered a simple means of adjustment. The other method of changing temperature conditions in the finer is to change the damper adjustment in order to increase or decrease the pressure in the tank, said to push or pull the heat to or from the finer. Adjusting finer temperatures by this method must, of course, often be at the expense of best conditions of combustion in the furnace. Furnaces which become choked as they grow older, so that the draft becomes reduced, will show an increased temperature in the finer in proportion to the melting end because of this gradually increasing pressure. Such a condition will finally arise that the glass is actually colder in the finer, although the temperature in the gas is hotter. Glass temperatures in the finer are largely controlled by the temperature of the glass in the melting end, and the rate it is being drawn from the tank. Temperatures taken in the hot gases above the glass, therefore, do not bear a direct relation to the temperature of the glass in this portion of the furnace.

Temperature readings of the glass, at the point it is being delivered to the machines, are perhaps the most important, but seldom taken by the use of pyrometers. Machine operators control this almost entirely by the apparent workability of the glass and unquestionably they become very good pyrometers under normal conditions. The assistance of a pyrometer properly placed would no doubt help considerably when conditions are not normal and finally become something to be greatly depended upon, as is often the case where installations are properly placed. Different conditions of operation as practiced by different machine men would also become more nearly alike giving a more consistent product. The position of a pyrometer to control glass at its delivery point will, of course, vary greatly with the type of feeder, but it seems most logical to put it at the last point in which temperature conditions may be adjusted before the glass is sheared.

Five points of temperature control have been suggested as the minimum necessary to form a reasonably good opinion of what is happening in a tank. To many, more or less familiar with tank operation, this will seem excessive rather than a minimum, but failure of pyrometer installations to be of any value may often be attributed to poor positions or an

insufficient number rather than the uselessness of pyrometers.

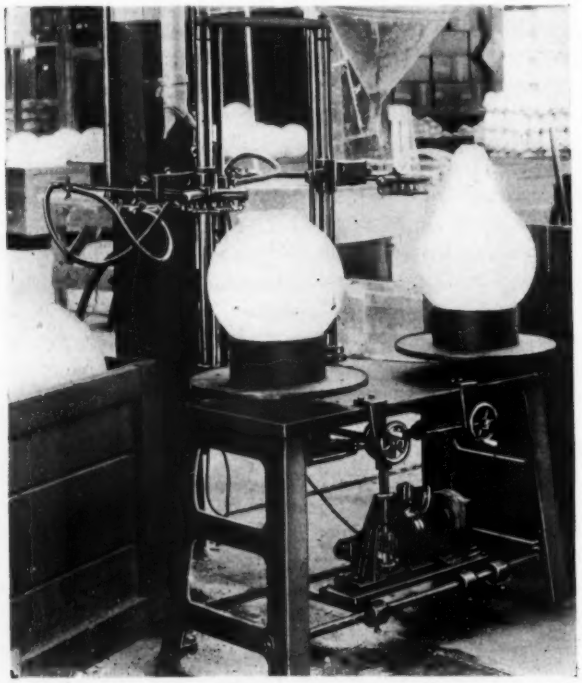
Pyrometer installations in the fining chamber or in the feeder may be permanently placed in the glass. Porcelain tubes will remain indefinitely in the glass where the temperature is not above 2,200 degrees F. A method of installation which may be used for these positions is to drill an inclined hole through the flux blocks, starting above the glass level at the exterior and entering the glass at such an angle that the end of the tube will be about three inches under the surface and about six inches from the wall when the blocks are new. Keeping just slightly under the surface will give reasonable assurance that gas temperatures are not being measured but still not give too great a lag in indicating changes in temperature of the upper layers of the glass.

Gas for Glass

By R. A. Hastings*

The essential base of all types of glass is silica and soda, yet while these are always the prime essentials, scientific discoveries have from the earliest time, so directed the artificer of this most useful commodity that no quality or variety of material and no color or shade of color is now impossible of production. There is scarcely an element that has not in some form been employed in glass-making, either for body or color. Sand, flints and various rocks have provided the silica, but sand is now almost universally used as being more free from the impurities which affect glass in substance or color and the most readily obtained, as well as needing the least preparation.

The unlimited supply of sand at Ottawa, Illinois, which is readily obtainable at Chicago, influenced a large glass plant



VERTICAL CRACKING-OFF MACHINE FOR LARGE WORK, USING MANUFACTURED GAS

to locate in the territory of the Public Service Company of Northern Illinois. This location provides a central shipping point as well as convenient material. Previous to this time, glass manufacturers were inclined to prefer the natural gas fields for the location of their plants, thus showing the importance of fuel in the process of converting raw material into the various shapes and forms of the finished product.

The chief products of this plant are illuminating glassware and glass cylinders for gasoline stations. In all, the company now manufactures seventy-five varieties of illuminating glassware for out-of-doors, as well as interior duty. All of these varieties require special molds and exacting methods of handling throughout a complicated process.

The glass is taken from the melting tanks, blown into various shapes by means of molds and placed into the annealing lehrs. From the annealing process, the units go through the "cracking-off" machines.

One of the first methods of cracking-off was by the use of a diamond point cutter. This was not entirely satisfactory on account of the long glass cylinders being subjected to stresses by the pressure of the cutting tool and because the cut might not be sharp, thereby causing a waste and loss in spoiled material. To insure speed, the glass cylinder must revolve rapidly and a greater pressure exerted by the tool with a resultant waste.

The next method of solving the cracking-off problem was by the use of the physical properties of glass. Like almost all materials, glass expands with heat and contracts with cold. It is a poor conductor of heat and when one surface is heated it will expand, but due to the poor heat conductivity the opposite surface remains constant. This condition produces a strain which shears the section.

By utilizing this physical property of glass, the problem resolved itself into a question of heat application. Oxygen and acetylene gas were used as a source of heat, which provided sufficient temperature, but gave rise to various other difficulties. Proper adjustment of the burner could not be maintained so as to provide the proper proportions at all times. As a result, much of the operator's time was consumed in regulating the apparatus, thereby cutting production to a large extent, and the cost of oxygen and acetylene made the cost of operation excessive. A separate department had to be maintained for supplying and servicing the oxygen and acetylene equipment.

The maintenance of this separate department combined with poor operation brought up the question of standardization. Gas, the versatile fuel, was used throughout the factory, and was by means of proper design of equipment, adaptable to "cracking-off."

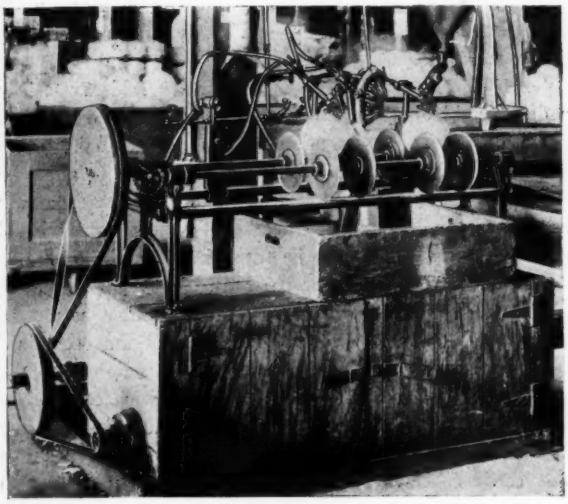
By close cooperation, engineers of The American Gas Furnace Company and the engineers of Public Service Company of Northern Illinois, designed new equipment, which solved the "cracking-off" problem, and incidently solved a general problem in burner construction.

In order to maintain maximum production, it was neces-

*Industrial Gas Department, Public Service Company of Northern Illinois.

sary to deliver a large volume of gas through the burner tips and apply it with a pin-point flame. This was impossible with ordinary burner construction because the necessary large volume of gas required a high velocity for delivery and this high velocity, being greater than the velocity of flame travel, blew the flame off the tip of the burner.

To overcome this difficulty, the burner tips were constructed six inches long, one-half inch in diameter, with a one-eighth inch orifice in the center and a one-sixteenth inch wide ribbon burner around the central orifice. The gas to the ribbon burner is supplied through special designed ports, which retard the velocity and give a perfect pilot light surrounding the high velocity gas released from a one-eighth inch central orifice. Eight of these burner tips are mounted on a semi-circular manifold in such a manner as to unite the end of each of the flames and form one central spot of concentrated heat.



HORIZONTAL CRACKING-OFF MACHINE USING MANUFACTURED GAS

The illustrations show two complete units of equipment for different types of work. The vertical machine is used for the larger single units and the horizontal for the smaller combination units, which are blown together in a series of two or three. There is a total of ten of these machines, used for the different type products, but all have essentially the same burner equipment, which is adjustable in four directions.

General practice is to run several thousand units of one pattern through the machine without a change, but often operating conditions demand several changes within the working day. This change formerly caused considerable delay in production, but is now accomplished in a few minutes without any trouble to the operator.

To assist in breaking after the flame heats the cylinder, an iron with heat conducting qualities is touched to the heated area producing a negative stress to the expansion, and the resultant effect is a square cut with no grooved edges.

This method increased production to the extent that the limiting factor is the speed at which the operator can shift the glass units on and off. One department now handles the ware from six annealing lehrs which are fifty feet long and ten feet wide, without any delay or excessive waste.

Once again it has been proven that you can "Do It Better With Gas," providing the proper design of equipment is used, no matter how intricate the operation may be. Also, it has been proven that the availability of natural gas is not a paramount consideration in the location of a glass factory or any other industry requiring a superior fuel.

Feldspar As a Source of Alumina in Glass

By George O. Smith*

Until comparatively recent years it was the belief that the presence of alumina was a decided disadvantage in glass. Henrivaux[1] considered that alumina caused greenish glass, and claimed that it made glass brittle, difficult to anneal, and less workable, and likely to cause want of homogeneity. T. J. Pelouze[2] thought that even small amounts of alumina made the glass more difficult to melt. However, both practical experience and scientific research have demonstrated that the presence of the proper amount of alumina in glass is very beneficial.

China clay, cryolite, hydrate of alumina, oxide of alumina, and feldspar are all used as sources of alumina in glass. China clay contains about 60 per cent of silica, and 40 per cent of alumina, but there is no decided advantage in its use. Cryolite is a double fluoride of alumina and soda, and it is seldom used except in opal glass. This material has a low melting point, and is a powerful flux, but it is extremely corrosive (as are any other fluorine containing compounds) on refractories, and its use should be avoided for this reason. Hydrate of alumina is a very pure form of alumina, but it contains 35 per cent of combined moisture, and is much more expensive than feldspar. In my own experience, batches containing either the oxide or hydrate of alumina have not been entirely satisfactory; as in several instances large, semi-translucent stones were formed in the glass. This may have been caused by the alumina in the batch being so highly concentrated, and on account of the high fusing point of these compounds.

The melting point of feldspar is from 2,000 to 2,200 degrees F., depending upon the composition of the particular grade of material used. The melting point of a pure potash feldspar would be 2,000 degrees F., and a spar that contained both potash and soda would melt more readily. The melting point of pure calcium oxide is 4,658, and that of the oxide and hydrate of alumina is 3,722, so it can be seen that feldspar melts at a comparatively low temperature.

Feldspar is a complex silicate of soda, alumina, and potash; and the alumina and other elements exist in a form that readily combines with the other batch ingredients. It contains no constituents that cause any chemical or mechanical disturbance in the glass and is not corrosive on

* Glass Technologist, The Ohio Hydrate & Supply Co.

tank blocks and pots. Feldspar has practically no loss in fusion, and is really an ideal source of alumina in glass.

The alumina obtained from feldspar costs about $0.035 per pound, as compared with nine cents in the case of hydrate of alumina, and eight cents for the oxide.

One hundred pounds of feldspar cost $0.60, and yield about 18 pounds of alumina.

Twenty-eight pounds of hydrate of alumina cost $1.68 (@$0.06) and give 18.2 pounds of alumina.

Eighteen pounds aluminum oxide yield 18 pounds of alumina, and cost $0.08 per pound. In other words, when 100 pounds of feldspar are used to the thousand of sand, a saving of $1.08 as compared with hydrate of alumina, and $0.84 as compared with the oxide, can be realized to each fifteen hundred pounds of batch. And, this is not taking into consideration the fact that out of every hundred pounds of feldspar, from ten to twelve pounds of combined sodium and potassium oxides can be obtained, which is equivalent to about 20 or 21 pounds of sodium carbonate, or soda ash.

From the above statements the reader will readily agree that feldspar is the most advantageous form in which to introduce alumina into glass. A high grade of feldspar will contain from 18 to 20 per cent of alumina, and from 10 to 12 per cent of alkali (soda and potash). Feldspar can be obtained with a ferric oxide content of one-tenth of one per cent or less, which is well within safe limits for flint glass.

Alumina in glass prevents or impedes devitrification, lowers the coefficient of expansion and contraction, increases the tensile strength, increases the brilliancy and luster, and may replace silica, lime, or soda. When alumina is substituted for soda, it produces a more solid, a more elastic, and a more ductile glass. It also increases the resistance to weathering and attack by chemical agents. Glasses high in lime are brittle and difficult to anneal, and when alumina is added to replace a portion of the lime, a much superior glass is produced. When substituted for the proper amount of silica, alumina slightly increases the fusibility.

From the preceding paragraphs, it can be seen that feldspar, since it contains an appreciable amount of alumina, possesses many favorable qualities when it is used in the batch. Batches containing feldspar produce a more balanced glass; in other words, the alumina and the alkali replace a portion of the fluxes in the batch, and in my own experience at least, feldspar batches are less severe in their chemical action on pot walls and tank blocks than straight sand-soda-lime batches are. Alumina may act as either a base or an acid; that is it can replace silica, soda, or lime. The fluxes (soda and lime) in the batch have a chemical affinity for the alumina and silica in the refractories; and when there is an excess of fluxing material present (as there usually is) the corrosive action is more severe. When there is alumina in the batch, any excess of fluxes tends to combine with the alumina, and the wear on the tanks or pots is less pronounced.

The amount of feldspar used for making transparent flint or colored glass may vary from 50 to 125 pounds to the thousand of sand, and depends upon the physical and chemical properties desired in the glass, and other factors which must be considered. In my own practice, the average for transparent glass has been from 75 to 100 pounds to the thousand of sand. In making opal, and other forms of opaque glass, as much as 500 or 600 pounds can be used.

An important item when alumina is added to the glass is whether or not the increase in viscosity is so great as to retard the plaining of the glass. I know of no actual determination that have been made how far alumina does affect the viscosity, and some claim that alumina in small amounts lowers the viscosity. Purdy[3] found a number of glazes which were both more fusible and less viscous when alumina was present than when it was absent.

The only instances where I have known feldspar to have a detrimental effect on the glass was in one case when too much was used, and in another instance where the proper batch adjustments had not been made in order to allow for the introduction of the feldspar. Of course, if feldspar was used with too high an iron content, greenish glass would result, but this would also be true of any of the other materials, such as the sand or the lime.

One other action that might cause trouble would be to introduce a feldspar batch into a tank that contained the ordinary soda-lime glass. Alumina-containing glass has a different specific gravity than that which contains no alumina, and if a batch with the full amount of feldspar was added suddenly to the tank, it would be very probable that cords or waves would result. When called upon to introduce feldspar into a tank, I prepare a chart or plan showing a change in the different batch ingredients every three or four days, and covering a period of ten days or two weeks. This eliminates the possibility of having two or three glasses of different composition in the same tank, and the resulting glass will be uniform in its properties when it is drawn from the working end.

A batch should never be adopted until a thorough study of the temperatures of the tank or furnace and of the furnace conditions is made whether the article is to be pressed or blown. Other factors of importance are the methods of feeding and working the glass, the size and weight of the article to be made, and the others which may enter into the determination of the correct formula for any individual requirement.

The use of feldspar has been opposed by some on account of the slightly increased cost involved in its use, but when a comparison is made between the relative merits and working qualities of glass made with and without feldspar, I believe that any reasonable added expense can be considered as negligible. An increase in the cost of the batch is not as important as it seems to be at the first glance, because it must be considered that the actual cost of the batch is but a very small percentage of the total manufacturing cost of a completed glass article. If a better glass is obtained, which possesses more favorable working qualities, it seems logical that a slightly increased cost of the batch is justified.

During the last few years the use of feldspar in the manufacture of bottles, jars, tumblers, and other pressed or blown articles has become very extensive, as many glass firms have found that they can make better glass, and increase their production by using feldspar.

[1] *J. Pharm Chim.* 1889 (5), 19, 446.
[2] *Compt.*, 1865, 60, 985. Ann. Chim. Phys. 1865, 5, 265.
[3] *Trans. Amer. Cer. Soc.* 1903, 5, 136.

The Thermal Efficiency of Glass Melting

A Discussion of Factors Governing Fuel Consumption

By D. J. McSwiney*

(*Continued from the July Issue*)

The factors pertaining directly to the thermal side of tank operation are those to which most attention is paid in a consideration of the possibilities of heat saving in glass manufacture. The basic principles of furnace operation are the same with all fuels; but the problem will be considered here more particularly from the view point of producer gas, because this fuel is probably the ultimate universal fuel for glass manufacture, at least for small plants, and because its use presents more difficulties and more opportunities for unnecessary heat loss than does the use of other fuels available for glass tanks.

The principle of producer gas formation depends on the fact that the combustion of carbon—the main constituent of solid fuels—can be considered as taking place in two steps; in the first step—that which takes place in the producer—the carbon combines with oxygen from the air blown into the producer to form carbon monoxide gas, and in the second step—that which takes place in the furnace—the carbon monoxide burns by combining with more oxygen to form carbon dioxide gas. In practice, this principle is combined wish that of water gas formation, which depends on the fact that when steam is brought into contact with red hot carbon, carbon monoxide and hydrogen are formed, both of which are gases and combustible. Other minor actions taken place in the formation of the gas, for example, as the coal in the producer falls to a point where the temperature is sufficiently high for producer gas formation to take place, it is first freed from moisture and is then slowly coked. In the coking process combustible gases and tarry soot are set free, the former constitute a valuable addition to the producer gas, while the latter is also combustible but is largely deposited in the gas canals.

In the first step of producer gas formation—that in which carbon monoxide is formed—about one-third of the available energy of the coal is set free in the form of heat, while in the second step—that of the burning of carbon monoxide to carbon dioxide—the remaining two-thirds of the energy is evolved. The formation of water gas in the producer by the use of steam does not evolve heat but on the contrary absorbs it, and it is in fact mainly on this account that steam is used.

The evolution of about one-third the available energy from the carbon in the formation of the producer gas would raise the producer and its contents to a temperature too high for practical operation, and by the use of steam to form water gas the heat in the producer evolved by the formation of carbon monoxide is partially absorbed and the temperature of the producer and its contents is kept within safe limits. In this way, the use of steam by reducing the temperature of the producer and the gas decreases loss of heat by radiation from the producer and gas canals; moreover, through the use of steam part of the energy of the coal which would normally be set free as sensible heat of the gas and which thus would be rendered non-available for a furnace equipped with efficient regenerators is stored up in the gas in a form in which it can be rendered available in the furnace. The use of steam in the producer gives a smaller volume of gas than would be obtained without the steam, but it gives a gas of much greater heat value and one which on burning will give a much higher temperature.

The primary object of gas producers for glass furnaces is to transform the solid coal into gas with as little change as possible of the energy stored up in the coal to sensible heat. If the producer gas were to be burned without passing directly to regenerators or recuperators the sensible heat of the gas would be effective, but with efficient regenerators, or some of the efficient recuperators lately developed, the temperature at which the gas and air enter the regenerators should have little effect on the temperature produced in the furnace by the combustion of the gas. The efficiency of a gas producer used with regenerative furnaces should be figured mainly on the cold gas, as the sensible heat of the gas is of little or no value as regards furnace operation.

The formation of producer or water gas requires a certain temperature and the rate of formation of the gas increases rapidly with increase above that temperature. The amount of steam which can be added effectively to the producer to absorb the heat evolved by the formation of carbon monoxide is limited by this fact, for if more than a certain amount be added, the temperature in the producer will fall to a point where gas formation is not sufficiently rapid and the quality of the gas will suffer.

While the amount of available energy of a combustible which is utilized in producer gas production is considerably less than that which is available through direct combustion of the material, it is the only efficient method at present available by which coal can be utilized for heating glass tanks without an expensive installation such as is necessary for the production of blue gas. In most glasshouses producer operation is a hit or miss affair, and the results obtained are often only what can be expected from this type of operation. It is only rarely the case that through intelligent control producers are operated at near their maximum efficiency.

Some heat is always lost through unburned coal in the producer ash, but while with poor operation the loss at this point may be considerable, with good operation and with coal which does not have too high or too fusible an ash, this loss is seldom over one per cent of the total available heat value of the coal and is usually less than half that amount. About one per cent of the total fuel value is lost through the cooling water in the producer and a similar amount through deposition of soot in the gas canals.

The heat value of a producer gas sometimes suffers to a considerable extent through partial combustion in the check-

* Consulting Chemist.

ers resulting from leaks in the regenerator walls or between the gas and air checkers. The presence of such leaks can be shown by analyses of samples of the waste gases and of the incoming producer gas taken at the top and bottom of the checkers on both sides of the tank. Any openings showing in the regenerators should, of course, be closed with clay mud.

With efficient regeneration, the gas and air on the incoming side should have a temperature of about 2,200° F. at the port, in the case of a tank melting at about 2,500° F. A cubic foot of producer gas of typical composition, say 24 per cent carbon monoxide, 6 per cent carbon dioxide, 56 per cent nitrogen, 10 per cent hydrogen, 3.5 per cent methane, and .5 per cent ethylene, having a fuel value of about 143 b.t.u. per cubic foot, will require a little less than 1½ cubic feet of air for combustion and will give about 2⅓ cubic feet of waste gas measured at about 2,350° F. As this waste gas passes through the checkers on the outgoing side its temperature drops through transfer of heat from the gas to the checker brick, which on the previous reversal had fallen in temperature by heating up the incoming gas and air. The temperature of the outgoing gas will fall only to a certain point in the checkers and the remaining heat in the gas will be lost by passage of the gas up the stack.

Because of the fact that the outgoing gas at the port is at a higher temperature and has a much higher specific heat—or heat capacity—than the incoming gases at the same point, the heat content of the waste gases at their point of exit from the furnace is much greater than that which is necessary to raise the temperature of the incoming gas and air from their normal temperature to approximately 2,200° F. If then, the checkers are of efficient construction and of sufficient capacity, they can extract from the waste gases and store up more than enough heat to raise the incoming gas and air to the desired temperature; even if the waste gases are cooled only to the temperature at which stack efficiency is the highest, or the producer gas is received at the regenerators much colder than the temperature at which it normally leaves the producer, there will still be more than enough heat set free and stored up in the checkers by the drop in temperature of the waste gas to preheat the incoming gases to the desired maximum temperature.

The theoretical maximum temperature obtainable by the combustion of the above preheated producer gas will be about 3,800° F.; however, the practical maximum temperature obtainable is limited by the fact that at temperatures near those used for glass melting the carbon dioxide formed by the burning of the gas begins to dissociate or decompose, and in this decomposition a large amount of heat is absorbed, this absorption tending to reduce the temperature which otherwise might be produced. So that instead of a maximum temperature of 3,800° F. the actual maximum temperature obtainable will be nearer 3,500° F. This dissociation does not however, cause any heat loss for as the gas cools down in passage through the furnace, the dissociated gas recombines and sets free as much heat as was absorbed in the dissociation. The degree of dissociation of carbon dioxide at glass melting temperatures is very slight, so that recombination of the dissociated gas is practically completed in the furnace. In other words, if the combustion could be completed instantly without radiation loss the theoretical maximum temperature could be attained.

As the burning gas passes through the tank it drops in temperature from transfer of heat from the flame to the glass and tank walls. This transfer of heat is necessary first, to supply the heat needed for the actual melting of the glass, and second, to maintain the glass and tank walls at the melting temperature by replacing the heat which is lost by radiation from the tank to the atmosphere and the objects surrounding the tank. As has been said, the requirement for the first action is small compared to that for the second. The process of supplying heat to the tank to overcome radiation losses is like that of keeping a constant level with water in a sieve; water must continuously be supplied to the sieve to take the place of that which leaks through the holes in the sieve; the smaller the holes the less water supply will be required; if the holes are plugged up, no additional water will be needed; and if more than the necessary amount of water be added, the level will rise and eventually overflow. Similarly, the amount of heat which must be supplied to a tank to keep it at a constant temperature level depends on the rate at which heat leaks through the walls either directly or through the glass and then through the walls; if the tank be partially insulated to partly plug these leaks, less heat supply, that is supply of gas or other combustible will be required to maintain this temperature level; if the tank were perfectly insulated no additional heat would be necessary to maintain the temperature level once the tank had been brought to this temperature; if more than the necessary amount of heat be supplied to the tank its temperature level would rise and tend to reach the maximum flame temperature. So that if a tank be insulated, in order to maintain the same temperature level which obtained before insulation, less fuel must of necessity be supplied it.

The rate of transfer of heat from the flame to the glass and tank walls depends on the difference in temperature between the flame and the glass and walls; the greater this temperature difference the more rapidly transfer takes place. For efficient heating of the glass in the tank, the temperature at which the burnt gas leaves the tank must be only slightly above the melting temperature desired. That is if the glass is to be melted at 2,500° F., the waste gas must leave the tank at a temperature only slightly above 2,500° F. If the temperature of the waste gas is much above this point, the heating will be inefficient and the temperature of the tank will tend to rise. If the waste gas leaves the tank at a temperature below this point, the temperature of the glass will fall.

(To be continued)

METHODS OF FUEL GAS ANALYSIS. S. W. Parr and F. E. Vandaneer of the Engineering Experiment Station, University of Illinois, have published a circular describing the analysis of fuel gas, which should be of interest to glass makers. Descriptions of methods to determine carbon dioxide, carbon monoxide, hydrogen, oxygen, methane, ethane, ethylene and benzene are given.

The authors have developed a special apparatus for the purpose of analyzing fuel gas, and give a synopsis of methods adapted to the new type of equipment. A review of methods to be used with other types of apparatus is included in the appendix of the circular.

Copies of Circular No. 12 may be had free of charge.

Causes of Crizzles and Skin-Wrinkles of Pressed Glass*

Explanation of Defects and Their Prevention

Practical experiments on the influence of temperature on the formation of wrinkles

By E. Zschimmer, K. Hesse and K. Meures†

(Concluded from the July issue)

It is a well known practical experience that glass pressed in a mold which is too cold will form not only crizzles but also heavy wrinkles. It is also an acknowledged fact that the tendency to form wrinkles depends to a large extent on the chemical composition of the glass.

In the preceding article it was shown how poorly adapted the glass was which was used in the experimental labratory work. It is true that the better grades of pressed glass are fire polished after leaving the mold. This is done either individually or as in American automatic glass factories by moving the ware through a fire of suitable temperature

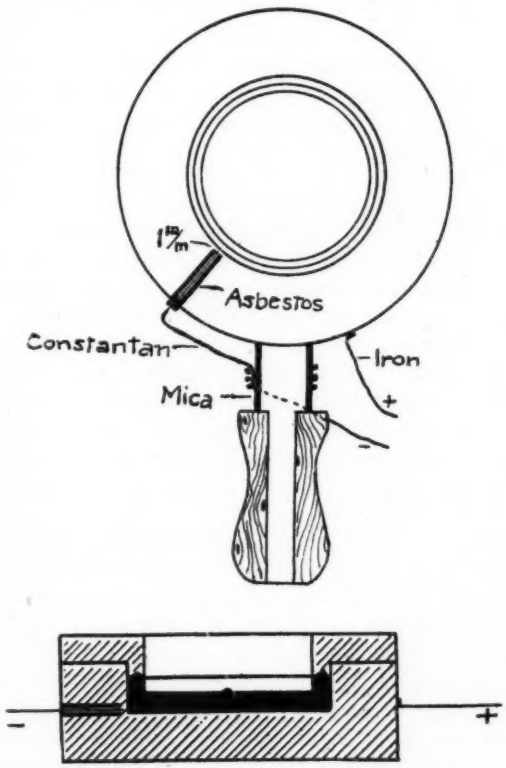


FIG. 20—MOLD WITH THERMOCOUPLE

on a conveyor. In this way the tough skin of the pressed ware is liquified to such an extent that the surface tension can become active as in blown glassware. It is evident that fire polishing will act more rapidly and will cost less, the more the formation of the larger wrinkles is prevented from the outset.

The selection of a glass batch which yields glass not inclined to form wrinkles is therefore of great importance. This is especially required in the case of ordinary, inexpensive pressed glassware, such as heavy tumblers, salt shakers, jelly glasses, presserve jars, fruit dishes, etc.

Formation of skin wrinkles and crizzles does not depend solely on the mold temperature and the working temperature of the glass. It depends largely also on the chemical composition. The composition of the glass used for experimental work was as follows:

		Per Cent
Silica	(SiO_2)	75.0
Alumina	(Al_2O_3)	0.6
Sodium oxide	(Na_2O)	13.9
Potassium oxide	(K_2O)	0.9
Lime	(CaO)	9.1
Zinc oxide	(ZnO)	0.4
Lead oxide	(PbO)	0.1

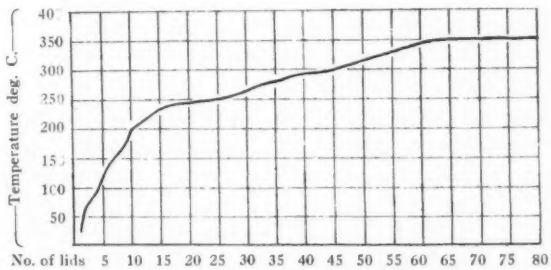


FIG. 21. HEATING OF MOLD THROUGH INCREASE OF THE NUMBER OF LIDS PRODUCED

If instead of this glass we had used the material employed in our previous experiments it is probable that much larger wrinkles would have been obtained. On the other hand it is probable that decrease of the amount of alkali in favor of the amount of alumina and silica would have further decreased the formation of wrinkles under the same conditions. It was our object to comprehend with some exactness the influence of the mold temperature.

The experiments were carried on in the glass works of the Putzler Brothers in Penzig (Oberlausitz). We selected as the object of our tests a glass lid of a preserve jar of the usual shape, that is with a flat upper surface and the lettering in relief on the inside. The mold is shown in Fig. 20 in plan and in cross-section. The black part represents the finished pressed glass lid. The ring-shaped part of the mold is removed regularly for the removal of the pressed article. To determine the temperature of the mold as closely as possible to the glass, the whole mold was used as a part of an iron-constantan thermocouple. On the outside of the mold, as shown in Fig. 20 an iron wire was welded and a wire of constantan was connected inside of a drill hole, and insulated by asbestos, reaching in as far as one millimeter from the inside wall of the mold. The two wires of the thermocouple were arranged in such a way

* *Sprechsaal* 58. Translated for THE GLASS INDUSTRY.

† Contribution from the Glass Research Laboratory of the Technological Institute of the University of Karlsruhe.

that the presser was not bothered by them. (The presser must move the mold by means of a wooden handle on a horizontal base; by doing this the two wires make a movement like a pendulum as can be seen in Fig. 20).

The presser commenced work with a cold mold so as to make possible a study of the increase in temperature which occurs with normal working speed. This was done by filling the mold repeatedly with new glass from the pot. In Fig. 21, the number of pressed lids is entered on the abscissa and the temperature registered by the thermocouple by means of a galvanometer on the ordinate[1].

The working speed was such that thirty-five lids were pressed in thirty minutes. The working temperature, measured with a Siemens & Halske Ardometer averaged 1120° C. The bottom part of the mold weighs 15 kilograms, a glass cover of 12 centimeter diameter weighs 85 grams.

The glass lids were pressed at 75°, 100°, 200°, 300° and 350° Centigrade. It was observed that the skin wrinkles, which were very apparent at 75° gradually decreased until a high grade article was obtained at 350° C.

The observation made may be of interest, that the presser chose the temperatures of 360° and 380° respectively for the two molds, used alternately, as the most suitable for his work. If the mold becomes too hot, the glass sticks to it. This happened when the galvanometer of the thermocouple indicated 400° C.

Influence of the Chemical Composition on the Tendency to Form Wrinkles, Waves and Crizzles

It has already been pointed out that the glasses used for our experiments were quite different from each other with regard to their tendency to form wrinkles. Their composition was as follows:

	No. 1 Per Cent	No. 2 Per Cent
Silica ..... (SiO_2)	75.5	75.0
Alumina ..... (Al_2O_3)	...	0.6
Sodium oxide ..... (Na_2O)	16.9	13.9
Potassium oxide ..... (K_2O)	...	0.9
Lime ..... (CaO)	7.2	9.1
Zinc oxide ..... (ZnO)	...	0.4
Lead oxide ..... (PbO)	...	0.1
Arsenic ..... (As_2O_3)	0.4	...

Glass No. 1, used for the making of the small cylinders (see previous article) is so strongly inclined to form wrinkles that it is not fitted for the manufacture of pressed ware. From glass No. 2 good ware can be made if the mold is kept at the proper temperature. This applies also to a glass containing some magnesia and some alumina having the following composition:

	Per Cent
Silica ..... (SiO_2)	75.7
Alumina ..... (Al_2O_3)	1.3
Sodium oxide ..... (Na_2O)	16.5
Lime ..... (CaO)	3.8
Magnesia ..... (MgO)	2.7

If the composition of these glasses is compared, the composition of the bad glass No. 1 with the two good glasses Nos. 2 and 3—it becomes apparent that the latter are substitutions for No. 1. The following changes were made:

(a.) Sodium Oxide (Na_2O) in No. 1 was replaced by lime (CaO). Disregarding some miner chemical changes, this produced glass No. 2.

(b.) In glass No. 1 magnesia (MgO) was substituted for lime and some alumina was added. This gave glass No. 3, when some unimportant changes are disregarded. It was noteworthy that glass No. 3, containing 2.7 per cent magnesia at 1400° C dripped off the punty and already during the melting process appeared considerably more liquid than No. 2. In other respects no great difference could be observed in their behavior. With regard to glass No. 3 it was noted that during pressing, under normal working conditions there was greater formation of wrinkles in No. 3 than in No. 2.

If it is assumed that glasses Nos. 2 and 3 are equally well adapted to the manufacture of pressed ware, it would prove that the proportions and the kind of glass forming oxides can be changed within comparatively wide limits without influencing materially the suitableness for pressed ware. This is a well known fact, proven by experience. On the other hand the composition of glass No. 1 which proved to be unsuited shows that it is important how the relation of the oxides is arranged. This practical conclusion which is derived from experience in glass works is theoretically easy to understand. It is reasonable that glasses of quite different composition should show the same behavior during pressing. For their behavior depends only on whether the glass mass, within the range of working temperature has approximately the same physical properties which influence the mechanical behavior of glass. It is well known that the same properties can be obtained with quite varying chemical composition. For instance glasses of greatly different composition have the same coefficient of expansion, the same viscosity, the same hardness, etc. It is also to be noted that the same physical behavior by glasses of different composition is the more difficult to obtain, the greater the number of physical constants which have to agree. The experiments show that the suitableness of glass for pressed ware depends on only two physical constants.

If it is correct that the formation of wrinkles during pressing is caused by the formation on the surface of the glass of a tough skin which is wrinkled when the inside of the glass mass shrinks, it is evident that the size of the wrinkles depends on the amount of contraction of the liquid glass. This shrinkage during falling temperature is just as large as the expansion with rising temperature within the same temperature range. Formation of wrinkles therefore depends on the coefficient of expansion of the glass during the temperature range in which the glass changes from a liquid to a solid condition. The glass with the smallest coefficient of expansion within the range of temperature suitable for pressing is the best adapted for the production of pressed ware. This glass will contract the least inside of the skin and will therefore show the least tendency to form wrinkles.

The appearance of crizzles depends on the formation of a skin of great toughness which is torn by the pressing operation. If the coefficient of expansion of the liquid glass is small, the glass will have only little tendency to form a tough skin on the surface. For the greater toughness of such

[1] Exact correction of the thermocouple was neglected since the measured temperatures have only a relative value as they refer to a point near the inside of the mold.

a skin as compared with the liquid glass inside is only an indication that the liquid glass mass during contraction has consolidated strongly. During the temperature range through which the liquid glass rapidly passes it takes up much less space than the hot liquid glass which it first surrounded. The formation of crizzles—insofar as it depends on the nature of the glass-mass—is dependent to a large extent on the co-efficient of expansion of the glass within the temperature range of the pressing operation.

This applies of course only with the understanding that glasses with a low coefficient of expansion must possess at the same time a sufficient degree of liquidity necessary for pressing at temperatures required to perform the work.

It should be mentioned that the coefficient of expansion of liquid glass at the temperature of pressing cannot be directly calculated from the average expansion of the glass between 20° and 100° C. Reference is made in this connection to the work of H. Schonborn.[2] In order to ascertain the most favorable composition for pressed glass it is necessary to measure the coefficient of expansion of various glasses within the range of temperature in which they have the proper viscosity for working. In this connection we refer to the exhaustive and fundamental study by E. W. Washburn and G. R. Shelton on the viscosity and surface tension of soda lime glasses at high temperatures.[3]

It is clear that next to the coefficient of expansion the change in viscosity of glass during falling temperature is of great importance for the formation of wrinkles and crizzles. It is well known to every glass presser that a glass with a long viscosity range is easier to work than one which sets rapidly. The former changes gradually from a thin liquid to a viscous condition, the latter changes its viscosity during cooling more or less suddenly. Its result is the formation of a tough skin, which is the fundamental cause of the formation of skin wrinkles and crizzles, which are more prominent in the case of glass with a short viscosity range. If the outside layer of a glass gather during pressing would keep the same viscosity as the glass, within the range of working temperatures—for instance between 1000° and 500° C., there would be no difference between the outside skin and the liquid inside part. In other words, the glass gather could be pressed into any form without the formation of wrinkles or crizzles on the surface of the finished article. In proportion to the increase, or possibly the accelerated increase in viscosity during cooling, the formation of a skin and therewith the appearance of wrinkles will occur.

It must be concluded therefore that the two physical properties upon which the formation of skin wrinkles and crizzles depend are first, the coefficient of expansion and second, the increase in viscosity within the working temperature range.

The following cases may present themselves in glasses of different chemical composition:

(a.) The glass has a small coefficient of expansion and sets rapidly.

(b.) The glass has a large coefficient of expansion and sets slowly.

(c.) The glass has a small coefficient of expansion and at the same time sets slowly.

Case (c.) would represent the most favorable glass for pressing. It is therefore important to find the most favorable chemical composition for pressed glass. This must in most cases be found in a compromise since it is not only necessary to select the most rational glass composition from a technical point of view, but also one which is not too expensive. Quality, freedom from color and from blisters are also of importance. These valuable properties should not be disregarded in a change of chemical composition aimed at prevention of wrinkles and crizzles.

[2] Zeitsch. f. Physik, p. 305, 22 (1924). Ker. Rundschaup. 17, 33 (1925).

[3] The viscosities and surface tensions of the soda lime glasses at high temperatures. University of Illinois, Engineering Experiment Station. Bulletin No. 140 (1924).

SUMMARY

1. To explain the behavior of liquid glass during working and to explain the occurrence of certain defects it is supposed that a gather consists of a tough "skin" which surrounds a liquid mass of glass. A gather intended for the formation of hollow ware consists of two "skins" of different viscosity, a drawn plate of glass consists of two flat "skins" between which the liquid glass moves, etc.

2. From this conception, the occurrence of wrinkles on the surface of glass cylinders, made by pouring or pressing in molds, are explainable.

3. A series of laboratory experiments are described which confirm the formation of skin wrinkles on the bottom surface of the glass cylinders. The number and size of these wrinkles depends on the temperature of the mold. This experiment may be used to study the formation of wrinkles under different conditions and with glasses of varying composition.

4. The experiments were continued in actual factory practice by pressing lids of preserve jars of the usual shape. An iron and constantan wire were fused onto the mold so that the temperature at one millimeter from the inside wall could be measured thermo-electrically. The influence of the mold temperature on the formation of wrinkles was proved with a glass of known composition.

5. It was found that the formation of wrinkles and crizzles depends on the coefficient of expansion and on the viscosity of glass.

6. The most favorable composition of a pressed glass is one in which the coefficient of expansion for the temperature range of pressing has the smallest value, while at the same time the glass sets slowly. Freedom from color and from blisters and the cost of the glass must also be considered.

Editorial Note

Dr. E. Zschimmer, co-author of the above article was for many years associated with the famous glass manufacturing concern of Schott and Genossen, Jena. In 1922 he accepted a call to take charge of the Department of Glass Technology of the Technical University of Karlsruhe. A number of important papers on the subject of glass technology have already been published in *Sprechsaal* by Professor Zschimmer and his co-workers. Among them the following are noteworthy:

The chemical relationship of glasses, enamels and glazes. Vol. 57, (1924.) Nos. 23-25.

The mirror group. Vol. 56, (1923). Nos. 28-30.

Notes on the soda, lime, silica diagrams of F. Gelstharp and J. C. Parkinson. Vol. 57. No. 38.

Professor Zschimmer is the author of a treatise in two volumes entitled "Theory of the art of glass making."

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A School of Glass Technology

All those interested in the glass industry, whether as manufacturers or as scientists, will hail with satisfaction the announcement that through the generosity of Isaac W. Frank a laboratory of glass technology will be established at the University of Pittsburgh to be located in the new "Cathedral of Learning."

If is the simple truth to affirm that the United States has become the leading country in the development of glass manufacturing and glass science. Yet there is at the present time no university or technical school where a young man can prepare himself adequately to enter the glass manufacturing industry.

In England a department of glass technology was established at the University of Sheffield nearly ten years ago. The name "Sheffield," which formerly only suggested "steel," is now inseparately associated with "glass" in the mind of every one concerned with glass manufacturing. One needs only to consult the pages of the *Journal of the Society of Glass Technology* to be impressed with valuable work done at this institution for the benefit of the glass industry.

In Germany, in spite of the distressing conditions created by the war, it has been realized that a training school for glass technologists was necessary if the country would keep abreast of the rapid advances made in glass manufacturing. In 1922 a department of glass technology was organized at the Technical University of Karlsruhe in Baden, and at the present time is well established and growing. A number of important papers have been published and are in preparation.

It is eminently fitting that a laboratory of glass technology should be located at the University of Pittsburgh. Although overshadowed by the enormously developed iron and steel industry the Pittsburgh district is and will probably remain the center of the American glass industry.

There are no less than sixty-two glass factories in the city and its vicinity, some of them exceeding in size and capacity any others in the world. In normal times they give work to 25,000 men who receive wages amounting to more than 20 million dollars a year. These factories are estimated to represent 250 million dollars of invested capital. Of plate glass alone the Pittsburgh area produces 60 million square feet per annum. There is probably no center anywhere in the world where there is more opportunity to study practical problems in glass manufacturing.

Undoubtedly the glass industry has entered upon a period of development and expansion that will break all previous records. The demand for trained glass technologists is becoming too insistent to be further ignored by our universities and technical schools. The fierce competition, especially in those departments of the industry that are decidedly overbuilt, calls for the utmost in technical skill.

The exceptional man will always be able to rise to leadership through the ranks. But for the majority the time that one could learn glass manufacturing in the school of experience is rapidly passing. The establishment of a glass laboratory and of courses of instruction by competent men at the University of Pittsburgh will be a powerful aid in maintaining our supremacy in glass manufacturing.

Laboratory of Glass Technology Planned for Pittsburgh

Initial Gift of Fifty Thousand Dollars to University of Pittsburgh for Establishing Training Center Made Known on July 9 in an Announcement to the Annual Meeting at Toronto of the American Ceramic Society.

By ALEXANDER SILVERMAN

Head of the Department of Chemistry, University of Pittsburgh

WHEN I was called into a glass factory as a chemist in 1902, just after graduating from college, there was little in America that might be honored with the title "Glass Technology." Chemists in the industry could be counted on the fingers of one hand. Today we find more chemists in the laboratories of a single manufacturer than the entire industry employed only twenty years ago.

In the University of Pittsburgh the study of glass has been confined to a lecture course on the subject; to graduate research by candidates for masters' and doctors' degrees; to investigations in the field of pure research, or in a consulting capacity by professors; and to the industrial researches under the fellowship system in the Mellon Institute of Industrial Research. The lecture course in glass technology has rarely been available for any but graduate students because of the importance of physical chemistry which students pursue during their senior year.

While it is not likely that students will be able to enter properly upon the study of the science of glass-making until they have had training in inorganic, analytical, and physical chemistry, and in the fields of physics and mathematics, one might perhaps have the freshman make silicate and borate melts during the study of silicate and boron, and later, when he studies the alkali and alkaline-earth metals, let him prepare a few simple glasses. Analytical chemistry might include the examination of raw materials and glasses, physical laboratory practice can cover the making of physical measurements on glass, and physical chemistry might include a study of eutectics and equilibria as well as the influence of temperature on chemical reactions and physical properties. Whether a four-year under-graduate course will be established to train glass technologists is still uncertain, but that a beginning will be made in training men for this important industrial field is assured by the receipt of the gift mentioned below.

PROPOSED CATHEDRAL OF LEARNING

Fifty-two story building which the University of Pittsburgh plans to erect, and in which the new Laboratory of Glass Technology will be located.

Men on the faculty of the University, and in the Mellon Institute, have made such progress in glass investigation during the past score of years that attention is focused on the University, with the expectancy of further development. Pittsburgh is one of the most important glass centers in the world, if not the most important. The industry began in this district in 1797. Natural gas and other natural resources of the region insured a constant growth. Pittsburgh district today manufactures more than one-half of the window glass of the United States and one-third of the plate glass and pressed and blown ware of the country. Its bottle plants turn out one-eighth of all glass containers used.

The University of Pittsburgh is glad to announce a gift of $50,000 for the establishment of the first "Laboratory of Glass Technology" in an American institution of higher learning. This will be a part of the Chemistry Department and will be located in the new "Cathedral of Learning," the 52-story building on which the University plans to begin building operations in the Fall, completing the structure in approximately three years. The contribution comes from Mr. Isaac W. Frank, in memory of his father, Mr. William Frank, one of Pittsburgh's pioneers in the glass field. It is expected that an additional amount will follow the original gift.

With this prospect, the University hopes to fill the long-felt need for the training of technical men for the glass industry.

Technical Consultation Service

QUESTION 74.—MANUFACTURING PROCESS OF PYREX GLASS.—I would be interested in having a description of the manufacturing process of the "Pyrex" glass, and would thank you to send me information on this matter.

ANSWER: Replying to your letter of April 15th requesting information with regard to the manufacture of Pyrex glass, we believe that Pyrex glass is made exactly like any other glass, only a higher temperature is required due to the fact that this glass is very high in silica and low in fluxing materials.

Silica and boric oxide both have a small coefficient of expansion. This gives the glass a high resistance against sudden changes in temperature. The boric oxide gives other valuable properties to the glass. A full discussion of the properties of glasses containing boric acid is contained in a booklet, issued by the Pacific Coast Borax Company, 100 William street, New York City, entitled "Boric Oxide as a Constituent of Glass." This booklet can be obtained by glass manufacturers, chemists, etc., free of charge by writing to the company.

The average chemical composition of Pyrex glass is as follows:

	Per cent.
Silica	80.5
Iron oxide	0.25
Alumina	2.00
Lime	0.29
Sodium oxide	4.4
Potassium oxide	0.20
Boric oxide	11.8
Arsenic pentoxide	0.7
Total	100.14

A discussion of the use of Pyrex glass in industry has appeared in one of the issues of *Chemical and Metallurgical Engineering*, 1923, and *Industrial and Engineering Chemistry*, 1923. The Corning Glass Works, Corning, N. Y., has issued a special bulletin on Pyrex glass which can be obtained on request.—J. B. K.

CULLET PILE PHILOSOPHY

By SILICA SAM

Inventories

Success magazines and home study volumes of many descriptions are filled with forms, routine methods and systems of all kinds for the detailed management of any kind of business or industry. But few of them lay down real basic principles.

Here's one as basic as capital itself:

Fight inventories down to the very minimum at all times. It is the easiest thing imaginable in a regular line organization for this principle to escape practice. It's very unusual for day workers, and sometimes uncommon for foremen and even higher salaried employees, to realize that carrying a thousand dollars' worth of stores or supplies for a year without using them means a loss of from sixty to two hundred dollars to their employers.

Some plants must be thus losing annually what would be a real fortune to Silica Sam, judging by the stock of batch materials, furnace repair materials, machine parts, crate and box shook, fuel, general supplies, etc., noted on hand year in and year out.

Of course, there is a margin of safety to keep inside of: The saving of a year by keeping inventories down can be lost in a few days by not having in stock what's needed to keep operating.

But stores and supplies should at all times be held down to the list of probable needs. One of the best ways to push profits up is to keep fighting inventories down.

Next to doing a job well yourself, there is no greater pleasure than that of having someone else do it well when you've asked him to.

Oversize Warehouses

Our ideas on this subject tie right in with our sermon about sitting on inventories to hold them down.

There's no arguing against the advisability of making stock at times to keep running through a short "slack spell." But every "slack spell" starts out to be a short one, and it seems, any more, that regardless of how little or how much warehouse room a plant may have, its warehouse is always much more than half full. At any rate, there are a great many more times the vast majority of warehouses are chuck full of product worth several thousand idle dollars than times when those warehouses are completely empty and customers are clamoring for their stuff.

There must be warehouses, of course, but beyond a certain amount of storage space in proportion to the rate of production, they become the worst spendthrifts and profit wasters around a plant. If they are there, they will be filled even though it would probably be far wiser and more profitable to shut down at times.

Turnover can mean no less to the manufacturer than to the retailer. If there's any profit in the game, more rapid turnover can mean only more profit. Oversize warehouses slow up turnover.

Handling and Loading

Opportunity for real practical salesmanship by factory executives is too often overlooked by them in not following their product more carefully after it is in the package. This opportunity is greater with glass products than any other.

Careful handling and painstakingly good loading can do much toward putting the glass into the customer's hands in as perfect condition as it was packed. More often than not this part of the work is left almost entirely up to a foreman who is good at getting the stuff out on time and getting the work out of his men, a crew of "treat 'em rough" huskies.

What can be more criminally careless than to neglect that part of the game and allow our well-made and well-packed product to be thus mistreated, and even ruined to some extent, before it leaves our own plant? A case or crate or a truckload of either will fall over now and then in handling. What do the men do when that happens? Watch!

Glassware received in wrecked condition is not going to make the customer "cuss" the railroad any harder than he always has. He can think only that he has received a mess of darn poor quality glass. Then all the careful supervision of manufacture, selection and packing is wasted.

MORAL: Follow your product until the car door is sealed on it.

Diagnosis

A gasoline engine in trouble is about the most contrary thing that ever came down the road. It wins that distinction only because glass house troubles and problems do not come down the road, usually.

Even a gas engine can be tamed in a short time, if its trouble is diagnosed properly or determined for certain, by proper tests or a process of elimination.

You'll think—"Here comes another science vs. rule of thumb argument"—but it's not—science is coming into its own in the glass game without any help from Sam.

What we're driving at, and we wish our playmates in this game would help us practice, is to reach decisions by systematic analytical methods rather than by a jump from mere opinions. Too many executives are too ready to hang their employees too often and too quickly when the glass goes bad or a machine breaks down, without thorough investigation. They are too ready to accept as the cause of trouble the first thing that comes to mind.

No doubt this is true of all branches of industry which makes it all the more worth striving to eliminate.

If a gas engine isn't doing its work because one cylinder is missing, the proper method of procedure is to find which cylinder is missing, then whether it is getting no spark, the intake valve doesn't open—and so on down to the very root of the trouble to be fixed. There is room for the adoption of such methods in glass factory procedure.

I find it easier to write precepts than to practice them.

Oversize Tanks

This topic is subject to the same remarks, almost, only stronger and more of them, that we made about oversize warehouses.

The tendency a few years ago was to build tanks bigger than necessary to take care of any possible "pull" that could be put on them, with the machine equipment to be used in connection.

It would have been far better and more economical to have built for the average pull and then, when necessary, to have pulled over capacity.

A very tidy sum of money can be used and tied up in:

1. Extra tank materials used in construction and repairs.
2. Extra fuel required to keep the excess body of glass hot.
3. Surplus metal in the tank at all times.
4. Extra space taken up in the factory.

We believe that some expected the oversize tank would not require such high heat and that the resultant saving in fuel and in wear on tank blocks would overbalance the above, but we have failed to hear of practice bearing out this theory.

We of the pinch-penny variety look at an oversize glass tank in the same light as we do a big heavy eight-cylinder car.

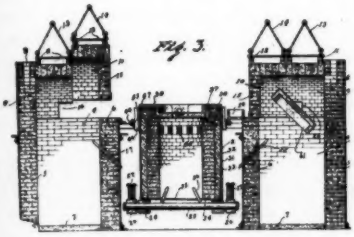
In gambling, one or more of the players must lose that others may win. This is known to everyone, except to a few women who have been misinformed by their husbands. But that principle is not true of the game we're playing. We can all win, and in working together to win, make the biggest killing. No one ever got ahead by holding someone else back. Let's be a team. And, let's give credit where credit is due that we may ourselves be worthy of credit.

Recent Patents

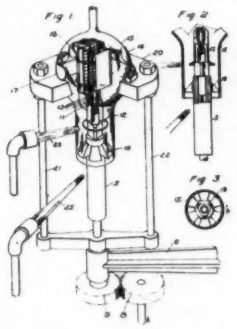
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

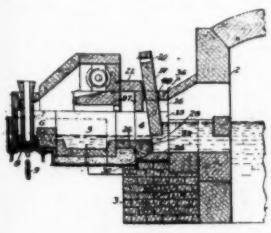
GLASS APPARATUS. 1,541,142. June 9, 1925. Robert W. Hilton, of Smethport, and John L. Graham, of Reynoldsville, Pa. Filed 12/3/20. The new feature is spaced draining furnaces open at their relatively adjacent sides, means for closing each furnace, a truck supported for travel between the draining furnaces, multiple pot-supporting means operable to alternately position the pots in operative relation to the respective draining furnaces, and a drawing furnace located between the draining furnaces and bodily movable upwardly and downwardly into and out of elevated position the furnace having a chamber in its top to enclose one of the supported pots when another pot is in operative relation to its respective draining furnace.



GLASS-WORKING MACHINE. 1,542,365. June 16, 1925. Joseph Branigan, Bloomfield, N. J., assignor to Western Electric Co. Filed 9/27/19. This invention relates to a glass working machine for sealing the electrode supporting stems of vacuum tubes to the external glass bulbs or envelopes. It includes a machine for sealing an electrode support in an elongated envelope having an opening in a constricted portion thereof, comprising a rotatable shaft, the electrode support being frictionally mounted on an end of the shaft, means comprising spring clips supported by the shaft for holding the envelope over and around the electrode support, and a petticoat on the shaft, the petticoat fitting snugly into the opening of the envelope whereby the envelope is steadied when the shaft is rotating, the petticoat having openings therethrough whereby heat may be supplied to the electrode support through the openings in the petticoat.

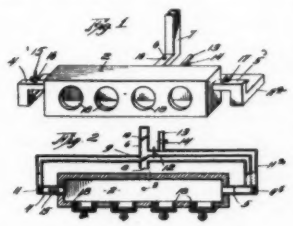


CUT-OFF BLOCK OR VALVE FOR MOLTEN GLASS. 1,544,987. July 7, 1925. George E. Howard, Butler, Pa., assignor to Howard Automatic Glass Feeder Co. Filed 5/11/22. A device for shutting off and controlling the rate of flow of molten glass from a tank furnace to another receptacle. It includes a cut-off block or valve for molten glass comprising a stationary member of refractory material having a flat surface, and a movable member of refractory material disposed on the intake side of the stationary member and having a flat surface engaging the said flat surface of the stationary member, the members having a substantial range of adjustment beyond their initial closing position, and being capable of wholly cutting off the flow of glass throughout the range of adjustment.

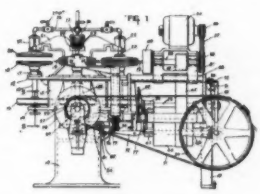


HEAT-INSULATING COMPOSITION. 1,544,196. June 30, 1925. Clark S. Teitsworth, Lompoc, Cal., assignor to Celite Products Co., Los Angeles, Cal. Filed 4/8/24. A heat insulating composition comprising diatomaceous earth, a binding agent, an organic gum capable of forming a gel with water, a fibrous material, and a distending agent.

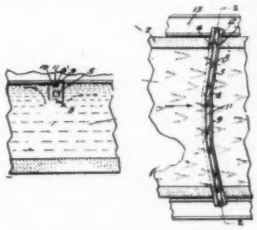
WINDOW-GLASS APPARATUS. 1,542,118. June 16, 1925. William Westbury, Caney, Kans. Filed 2/19/23. This invention relates to a glass making apparatus, a pot kiln having a plurality of openings, conduits communicating at one end with the kiln at opposite points thereof, a flue connected to the opposite ends of the conduits and open at one end, a stack connected to the other end of the flue, a valve for establishing communication between the rear end of either of the conduits and the open end of the flue and between the rear end of the other conduit and the stack, means for discharging a combustible mixture into the kiln from the conduit in communication with the open end of the flue, to sustain combustion in the kiln, and means for facing pots in the kiln through the openings of the latter.



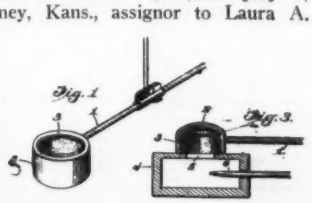
GRINDING AND SMOOTHING MACHINE FOR GLASSWARE. 1,540,474. June 2, 1925. F. L. Hitchcock, of Indianapolis, Ind., assignor to the Marietta Manufacturing Co. Filed 7/14/22. One feature resides in the pneumatic means for securing and clamping circular glass plates in position for the grinding and smoothing process. Another feature resides in the means for centering the plates between the clamping members. Other features relate to the mechanism for rotating the carriage whereby the glass plates will be first presented to the grinding element and thereafter presented to the smoothing element after the edges have been ground and to the driving mechanism for rotating the clamping members and glass plates at one speed as they are presented to the grinding element and at another speed as they are presented to the smoothing element.



GLASS FURNACE. 1,538,215. May 19, 1925. Joseph A. Reese, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 4/7/24. This invention relates to a process of skimming the surface glass in a continuous tank furnace, consisting in obstructing the flow of the upper glass strata, separating the upper surface glass from the main body of flowing glass, flowing this glass transversely from the tank into tanks of water which convert it into cullet.



METHOD OF DRAWING GLASS CYLINDERS. 1,545,222. July 7, 1925. William Westbury, Caney, Kans., assignor to Laura A. Westbury, Independence, Kans. Filed 9/26/21. This invention includes a method of drawing glass cylinders, which consists in providing a ladle having a glass receiving chamber internally lined with a highly refractory material capable of being heated without disintegration to a temperature above the temperature of a charge of



liquid glass at drawing temperature and of storing up such a degree of heat therein, heating the ladle while in inverted position by the application of flames concentrated within the ladle and projected from below directly against the lining so as to apply to and store up in the lining a degree of heat sufficient to maintain portions of a glass charge contained in the chamber and lying in contact with the lining in liquid condition during an entire ladling period, filling the ladle with a charge of molten glass at a temperature suitable for drawing a cylinder therefrom, pouring the charge into a heated drawing pot during a period while the portions of the charge in contact with the lining are kept liquefied and above congealing point by the abstraction by the charge from the lining of the heat stored therein, and then drawing a cylinder from the charge.

METHOD OF MAKING SUSPENSION INSULATORS OF GLASS. 1,542,588. June 16, 1925. Erich Schott, Jena, Germany, assignor to the firm Jenaer Glaswerk Schott & Gen., Jena, Germany. Filed 2/6/25.

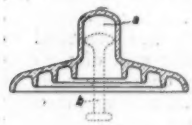


Fig. 1

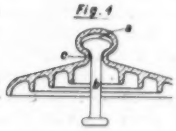
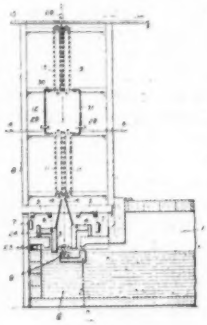


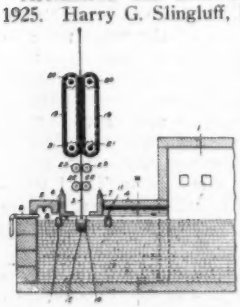
Fig. 2

This invention includes a method of making suspension insulators of glass, consisting in this that a glass body is first shaped in such a way as to receive a hollow space, adapted to receive a clapper, that thereupon a clapper is inserted and finally the glass is pressed round the clapper, so that after the hardening of the glass the clapper cannot be pulled out from the hollow space. It is easily possible to leave an interval between the glass body and the clapper, to avoid any objectionable influences of the clapper upon the glass.

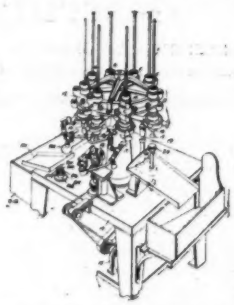
APPARATUS FOR DRAWING GLASS. 1,544,947. July 7, 1925. Harry G. Slingluff, Mt. Vernon, O., assignor to Pittsburgh Plate Glass Co. Filed 12/5/18. The invention relates to an apparatus for drawing glass in sheet form continuously from a bath of molten glass, a pair of opposing belts or bands of flexible asbestos fabric, means for driving the belts, and a plurality of rows of independently movable presser members arranged in series across the backs of the belts, the members being arranged to yieldingly engage the backs of the belts to cause them to engage the glass sheet lying therebetween, one object being the provision of improved means for continuously drawing and annealing glass sheet.



APPARATUS FOR DRAWING SHEET GLASS. 1,544,948. July 7, 1925. Harry G. Slingluff, Mt. Vernon, O., assignor to Pittsburgh Plate Glass Co. Filed 11/8/21. The invention relates to an apparatus for drawing sheet glass upwardly from a tank. It has an improved apparatus designed to prevent the line of generation of the glass from moving or shifting its position longitudinally of the drawing tank, and for preventing the sheet from warping during the drawing operation, while at the same time avoiding the objections as to lining or marring incident to drawing from a clay slot. It includes a clay bar extending transversely from one side of the tank to the other and entirely submerged beneath the glass of the tank with the glass of the bath lying over and contacting with the upper surface of the bar and provided with a vertical slot lying longitudinally thereof and extending therethrough, and means for drawing a sheet upward from the glass above the bar and in alignment with the slot, the slot increasing in width from the upper to the lower side of the bar.

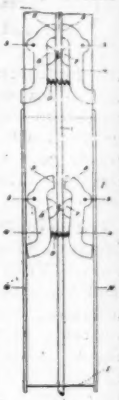


GLASS-SEVERING APPARATUS. 1,546,352. July 14, 1925. Francis J. Rippl, of Cleveland, Ohio, Assignor to General Electric Company. Filed 7/8/21.

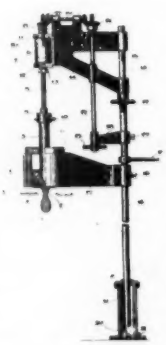


The invention relates to an apparatus for severing glass tubes comprising a carrier for receiving a series of tubes and maintaining them in a substantially vertical position, means for rotating the carrier, means for rotating the tubes, means for fusing each of the tubes in succession at the severing point, a pair of cutters mounted adjacent to the path of travel of the tubes, means whereby one of the cutters is caused to enter the tubes successively, means for rotating the cutters and means for forcing them together.

MEANS FOR DRAWING HOT GLASS TO GLASS TUBES. 1,545,349. July 7, 1925. Walter Riedel, Unter-Polaun, Bohemia, Czechoslovakia. Filed 3/6/25. This invention provides means for the production of glass tubes by drawing, comprising in combination an endless band capable of traveling in one direction on which spring actuated gripping means are provided, which are capable of opening and closing to grip the work, draw it out and release it again, gripping members mounted in pairs on the band, so as to be capable of pivoting in the plane containing the axis of the glass tube, resilient means capable of coacting with the gripping members for causing them to grip the tube, gripping jaws on the gripping members, which jaws lie in front of the pivotal points of the gripping members in the direction of travel of the band and interengaging abutments on the gripping members, capable of rendering the position and motion of the gripping members symmetrical with respect to the glass tube.



PLUNGER-OPERATING MECHANISM FOR GLASS FURNACES. 1,542,013. June 16, 1925. Thomas Stenhouse, Washington, Pa., assignor to Hazel-Atlas Glass Co. Filed 3/22/22. The invention relates to plunger operating mechanisms for glass furnaces, and one of the objects of the invention is to greatly simplify the plunger operating means by the employment of fluid pressure for operating the plungers. The invention comprises a glass furnace including a flow spout, a plunger adapted to reciprocate in the flow spout, a standard, a fluid pressure cylinder carried by the standard, and operatively connected with the plunger, means for lifting the plunger entirely clear of the flow spout, and for swinging the plunger laterally after it is clear of the flow spout, means for vertically adjusting the cylinder, means for bodily lifting the standard and the parts carried thereby, and means for rotating the standard and the parts carried thereby.



GLASS AND COMPOSITION THEREFOR. 1,545,508. July 14, 1925. Robert J. Montgomery, of Rochester, N. Y., assignor to Bausch & Lomb Optical Company. Filed 4/2/23.

The invention relates to improvements in the composition of crown glass, yielding a glass of approximately the following composition:

	1	2	3	4	5
SiO_2	72.0	67.0	65.6	72.5	66.0
Na_2O	14.7	13.6	13.6	15.0	14.0
CaO	10.5	9.7	0.0	10.5	0.0
B_2O_3	0.3	0.3	0.3	0.0	0.0
Sb_2O_5	2.0	8.9	20.0	2.0	20.0
As_2O_3	0.5	0.5	0.5	0.0	0.0
	100.0	100.0	100.0	100.0	100.0

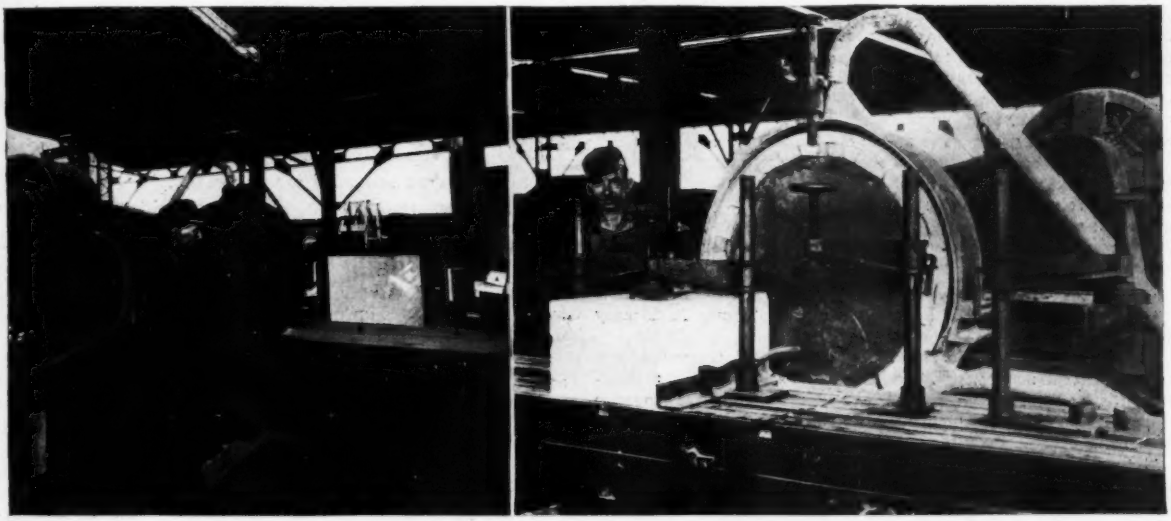
Glass Factory Equipment and Supplies

THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufactruers of the products described.

Tank Block Dressing Machine

The practice of grinding the surfaces of refractory or flux tank blocks to practically true planes and exact dimensions, after the burning process is completed, has been adopted by several refractory manufacturers and has grown rapidly in the favor of glass manufacturers, many of whom demand this faced-off finish and consider the advantages gained well worth the few extra dollars it costs per ton.

This demand has led to the development of several different machines designed to do the work quickly and economically. The one shown here at work in the plant of Laclede-Christy Clay Products Company, St. Louis, Mo., was built by the Diamond Machine Company, Codding Street, Providence, R. I.



TWO VIEWS OF TANK BLOCK GRINDING MACHINE AT LACLEDE-CHRISTY WORKS

The principle upon which it operates may be understood from the illustrations. The block, clamped firmly to the traveling table, is moved at a uniform speed across the face of the grinding "wheel" which consists of a sectional ring of abrasive brick. The machine is motor driven and equipped with a dust collecting system attached, as shown at the right, in a manner which results in efficient operation.

The view on the left shows the finished surface of a block after it has been ground. Laclede-Christy report that since finding the proper quality of abrasive material for the grinding wheel the machine has proved satisfactory for the new work and that it has been in almost constant use since installed. As an indication of the demand for accurately dressed blocks, R. A. Burns, director of Laclede-Christy Glass Industry Refractories Division, states that at present the machine is running 22 hours every day except Sundays.

Bearings have solid phosphor bronze bushings 5½ in. long with oil rings. A 10 H. P., 50° type, 1800 R. P. M. motor is used for driving abrasive wheel with sprocket and silent chain, and a ¾ H. P., 1200 R. P. M. motor for driving table through 2 in. belts. Wheel speed is 750 to 900 R. P. M. Table speed 26 ft. per minute Cross feed has a range of from .0005 in. to 1/32 in. Main water tank holds 30 gallons; settling tank 3 gallons. A centrifugal pump is provided.

The grinding wheel is 18 in. outside diameter, 15 in. inside, and 4 in. deep. The floor space for a machine with 60 in. table is 6 ft. 2 in. by 13 ft. 6 in. Net weight with motors is 5600 pounds, crating 600 pounds.

Facing Bottle Molds

The Diamond Machine Company specialize in heavy duty grinding machinery and their face grinders are adapted for, and are in use in the mold shops of prominent glass factories. Their 18 in. machine illustrated here has a capacity for work up to 60 in. in length and 14 in. in height with guard flap removed, and up to 10 in. with guard flap in place.

The bed, with three point bearing on the floor, is 120 in. long. Platen is furnished in sizes from 24 in. to 60 in. long and 14 in. wide. Diameter of spindle is 3½ in. front and rear bearings.

FACING BOTTLE MOLDS AT OWENS BOTTLE COMPANY

The American Blower Company has issued Bulletin No. 3506 entitled "ABC" Steel Plate Exhaust Fans, a copy of which may be obtained from the company's office at Detroit, Mich.

Flint and Lime Glass Manufacturers in Annual Meeting at Atlantic City Addressed by Leading Glass Makers

Uniform accounting systems, service to our industry, cooperative advertising and standardization were among the outstanding constructive suggestions made in addresses delivered before the annual meeting of the Flint and Lime Glass Manufacturers' Association.

The meeting was opened by an address by the president, W. A. B. Dalzell of the Fostoria Glass Company. This was followed by addresses by Charles H. West, president of the Westmoreland Glass Co., George Dougherty, general manager of the Economy Glass Co., and H. L. Heinzelman, president of the Monongah Glass Co.

President Dalzell said in his opening address:

"In my opinion, the cost of our product is most essential to our industry. We all should adopt a uniform cost accounting system. It certainly is a good system to know every month just how much you have made or lost the month previous, and to get this information it is not expensive to maintain. Quite a few of our members have such a system. All the rest should adopt it without delay. They will find it one of the best investments they can possibly make, to know the actual cost of each item you produce and have it prove itself at the end of the year.

"It would be of great value to this association's efforts to gather more statistics than has been our recent custom. We should know the volume of business our members do each year and have it divided up into various groups, such as the hand made pressed ware, machine made pressed ware, blown ware, stemware and blown tumblers, lighting goods, etc.

"Such information would be valuable to your tariff committee."

Charles H. West said in his address entitled "Home Missionary Work":

"The great sum of the sale value of imported glassware is a most important matter for American wares and a loss of employment for our workmen. We cannot ask for a complete stoppage of imports, but we ought to be able to compete in our own market on a more equable basis than that now prevailing.

"Suggestion has been made by some manufacturers that steps be taken to place before the American public a greater knowledge of our wares either through a publicity campaign or cooperative advertising. This would be costly, perhaps, but might be carried on with a reasonable expense. It would be of assistance if all of us and all our workmen continuously preach American glassware to all with whom we come in contact. Many distributors and retailers would be glad if we could place glassware more strongly before the public—not individually, but as a group of manufacturers.

"To appeal to patriotism would be of doubtful value because the American people consider price and appearance more than price alone. The appeal must be made on the service of our product and toward a wider use of glassware. We can increase our sales by some such method and also curtail imports. We have in this country an 'import complex' which affects other industries as well as our own. The china dinnerware trade, for instance, has suffered more than we have because of great imports.

"Each manufacturer can, if he will, spread more widely in his own district, in his home town and among his friends the facts in the glassware trade. Many are unthinking and it may often be the case that our closest friends will buy goods because they do not realize the actual situation.

"The glassware industry ought to become more vocal—telling the American public more about what it makes and why its wares are superior. Each manufacturer should be a continual speaker for the common cause and each of his employees should do their part. The wealth of America depends upon the prosperity of its workingmen and we cannot patronize stores and distributors who buy their goods abroad, when our factories are idle, or our workingmen are earning only sufficient to provide for common needs."

George Dougherty said in his address entitled "Progress and Service":

"When we legislate against criminality we are protecting ourselves against selfishness and greed, for out of them arise all criminal tendencies. The anti-trust laws are intended to protect the public from those who place self above service. A fair public, and the highest court representing it, does not condemn the organization that uses its strength to improve its service in the public interest and the condition of that part of the public who have their skill, time and funds invested therein. In the past the mere mention of an efficient trade organization meant to some people a price combination. This is not the progressive idea because it has long since been proven that unless a positive monopoly exists such an arrangement does not work out in practice. On the other hand, even if it were not contrary to law and public opinion, it is, in effect, stifling to incentive and restrictive to originality in an industry where artistic product counts for so much.

"So we are on firmer ground if we approach the idea of trade organization from the unselfish side. If we can think of our association as a common ground where we can give something for the common cause out of our particular experience or ability; where we can cooperate for the improvement of our product and its distribution; where we can increase the respect for the reliability of our industry; where we can further its dignity and maintain its respectability—then in the giving we will gain more in every way. If we can rise above the trivial detail of the moment and extend our vision to see the forest instead of the individual tree, then we will realize the Rotary slogan of—

"'Service above self. He profits most who serves best.'"

H. L. Heinzelman said in his address entitled "What Is the Matter with the Flint Glass Industry?":

"Naturally, you may be thinking that, as I have been audacious enough to outline some of the evils in the industry, I have a remedy. I sincerely wish that I had a 'sure cure' to recommend, but I have none. However, I will endeavor to outline some things that occur to me that might help:

"*First.*—A standardization of shapes and sizes in all staple articles, thus cutting down enormous and useless expense of molds, and consequently, a reduction in overhead in a number of ways.

"Standardization really had serious consideration during the World War but was dropped after the Armistice, so far as our industry was concerned. Some other industries carried it through to a great advantage to themselves.

"*Second.*—Curtailing the number of decorative designs we bring out. I appreciate the difficulty in bringing that about, but unquestionably it would effect a saving and without particular disadvantage to anyone.

"*Third.*—As demand falls off curtail production rather than sacrifice prices, because, inevitably, although it is possible to get a little additional business at sacrifice of prices, it is but a flash in the pan and when the smoke clears away you are not only operating on a curtailed schedule but are selling at sacrifice prices made in an effort to operate 100 per cent. capacity, and it is easy to see the financial result. Think it over.

"*Fourth.*—I am a firm believer in a uniform cost system, as it would clearly show to each of us in the same way just what difference in costs result in a certain percentage of curtailed production, and I am sure some of you would be as much surprised as I was after having a complete unit cost system in operation.

"I hope you will understand that I am not the press agent of any individual or firm whose specialty it is to install unit cost systems. In fact I am prompted by selfish reasons in urging all of you who do not have it to save money by having it, and, remember, it is not spending money to get it.

"If all had the same system, thus making it possible to maintain a statistical bureau, we all could have a better grasp on our industry and not blindly endeavor to force a market for our product by cutting prices to unprofitable points. Another thing to think about."

The officers elected for the ensuing year are:

W. A. B. Dalzell, president; Nicholas Kopp, vice-president; Frank W. Merry, vice-president; E. P. Ebberts, treasurer; John Kunzler, actuary.

The following firms were represented:

Belmont Tumbler Company, R. C. Faris.

Cambridge Glass Company, W. C. McCartney and W. L. Orme.

Economy Glass Company, D. H. Courtney, D. H. Courtney, Jr., and George Dougherty.

Erskine Glass & Mfg. Company, William Erskine.
Fostoria Glass Company, W. A. B. Dalzell and C. B. Roe.
Gillinder & Sons, John J. Beattie.
Gleason Tiebout Glass Company, Charles F. Gleason.
Hocking Glass Company, I. J. Collins.
Imperial Glass Company, Victor G. Wicke.
Indiana Glass Company, Frank W. Merry.
Inland Glass Company, C. J. Nolan.
Jefferson Glass Company, L. O. Griffith and William R. McCleary.
D. C. Jenkins Glass Company, D. C. Jenkins.
Monongah Glass Company, H. L. Heintzelman.
McKee Glass Company, M. A. Smith.
H. Northwood Company, D. A. Taylor.
Phoenix Glass Company, E. P. Ebberts and Thomas W. McCreary.
Pittsburgh Lamp, Brass & Glass Company, Joseph Huit.
Rodefer Glass Company, C. M. Rodefer.
U. S. Glass Company, Frank Baggs.
Westmoreland Glass Company, Charles H. West.
Pittsburgh Plate Glass Company, Refractories Department, M. B. Babcock.
Eagle-Pitcher Lead Company, H. W. Chatham.
Buckeye Clay Pot Company, F. H. Neipling.
Crockery & Glass Journal, F. C. Demarest.
The Glass Worker and China Glass and Lamps, J. G. Kaufman.
Pottery Glass & Brass Salesman, H. R. Handy.
GLASS INDUSTRY, J. B. Krak.

The Glass World and What It Is Doing

News of the Industry

Foreign Commerce Continues to Increase in May

Both exports and imports increased during May as compared with the preceding month. The total figure for exports for the eleven months ending May, 1925, however, remains well below that for the same period of 1924. The decline in imports for these periods is much greater, showing a drop from $22,462,869 to $15,844,739.

Exports of window glass increased from $13,383 to $14,349. Plate glass exports rose from $36,728 to $49,376, glass containers from $294,450 to $344,990. There was a decrease in the value of plain table glassware exported from $171,638 to $168,117. Exports of table and other glassware, cut or engraved rose from $12,100 to $18,601. Exports of lamps and illuminating ware decreased more than 50 per cent, from $27,298 to $12,205. The value of electrical glassware exported also decreased substantially.

Imports of window glass decreased from $271,493 to $152,624. The value of plate glass imports rose from $734,044 to $749,653, that of glass containers from $10,779 to $12,931, cut and decorated glassware from $144,601 to $164,555. There was a decrease in the imports of chimneys, globes and shades from $110,558 to $91,503. Other items showed unimportant changes.

Use of Manufactured Gas Increasing

The American Gas Association reports that the manufactured-gas companies of the country are rapidly preparing themselves to take on the heating load now being carried by natural gas and it is believed to be a reasonable assumption that within the next ten years manufactured gas will supersede as much as 20 per cent of the present supply of natural gas in the ten states east of the Mississippi that have this fuel. This means that an additional 80,000,000,000 cubic feet of manufactured gas would be made to substitute for natural gas.

In at least two cases, in Ashtabula, O., and Elmira, N. Y., companies formerly supplying natural gas have built plants and converted their lines almost entirely to carry the manufactured product. A number of other companies, notably the Equitable Gas Company of Pittsburgh, the Union Gas and Electric Company of Cincinnati, and the companies supplying the cities of Cleveland and Columbus, O.; Erie, Jamestown and McKeesport, Pa.; Buffalo, N. Y.; Richmond, Ind., and Hamilton, Ont., have constructed gas plants to augment the failing natural supplies.

American Stained Glass Window in Memory of Grotius

The Netherland-America Foundation intends to commemorate the three hundredth anniversary of the first publication of Grotius' masterpiece on international law, "De Jure Belli ac Pacis." It is proposed to raise a fund of $10,000 to build a memorial window to be presented to the Nieuwe Kirk at Delft—the Dutch Westminster Abbey—where Grotius lies buried. The window is to be of American design and careful steps will be taken to make it an adequate memorial in every artistic and practical sense.

It is the intention of the Netherland-America Foundation to approach the legal profession through the various associations of the bar, so that the windows in memory of Grotius may be the gift of the American bench and bar. Individual subscriptions may be small as the amount needed is modest, and the legal profession throughout the United States will be asked to contribute. The expense of the collection and preservation of the fund will be borne by the Foundation to the end that the full amount collected may go to the purpose for which it is given.

Among the subscribers are: Newton D. Baker, Paul D. Cravath, John W. Davis, Robert W. de Forest, John Bassett Moore, Franklin D. Roosevelt, Elihu Root, William Howard Taft and George W. Wickersham.

Foreign Stained Glass

A letter published recently in *The Sun*, New York, and signed by "An American" comments on the use in America of foreign stained glass, as follows:

> "I paid a visit to the Little Church Around the Corner the other day. At the entrance I saw the Joseph Jefferson Memorial window unveiled on the 20th day of February.
>
> It struck me very forcibly that an American actor and artist who himself designed two very large stained glass windows for his own residence, and which were made in this country, and an American first, last and all the time, should have a memorial window in his memory made in a foreign country.
>
> Do the people realize that it is this condition of affairs that keeps about one-half of the stained glass workers walking the streets looking for work when the same class of work can be made in this country equal to the work made in any foreign country?"

Glass Trade in the Irish Free State

Statistics now available on the glass trade of the Irish Free State, supplementing those published in the December, 1924, issue covering the first seven months of that year, make it possible to give now the complete record of 1924 importations (on the basis of $4.77 to the pound sterling) as follows:

	Quantity.	Total Value.	British Share.
Illuminating glassware	.....	$115,070	$68,325
Domestic and fancy glassware	22,273 cwt.	327,064	179,967
Plate glass	282,085 sq. ft.	222,601	200,879
Sheet glass	2,491,520 sq. ft.	272,262	135,015
Bottles and jars	106,459 gross	490,303	392,766
Glass and glassware, n. e. s.	4,796 cwt.	118,053	107,801
		$1,545,353	$1,084,753

Of the above total about 70% is attributed to the United Kingdom, and of the balance, $460,600, the amount of $207,900 is credited to Belgium, $73,520 to Germany, $42,677 to Czechoslovakia and $136,503 to other countries.

Glass Container Association Meeting at Atlantic City

At the meeting of the Glass Container Association, held at Atlantic City on July 30 in the Marlborough-Blenheim Hotel an important discussion was held, occasioned by the recent decision of the United States Supreme Court in the Maple Flooring and Cement

cases. This decision was the first definite indication as to what trade associations may legally do in the matter of gathering and disseminating statistics.

The main object of the conference was to discuss the proposed establishment of a Statistical Bureau in the Glass Container Association.

Preliminary to the presentation of the plan, an address was delivered by Dr. Lewis H. Haney, Director of the Business Research Department of New York University.

Decision Favors Illinois Glass Company

A dispute arising from a misunderstanding between Kelley Brothers Construction Company, East St. Louis, Mo., and the Illinois Glass Company, Alton, Ill., concerning the construction of the latter's new glass factory at Bridgeton, N. J., came to trial recently. The jury's verdict was in favor of the glass company. The plaintiffs claimed that their contract covered a factory building 330 x 700 ft. and that they assembled equipment for a job of that size, but that when 220 ft. of the building was complted they were ordered to stop work. They filed claims for loss of profits and damages incurred amounting to about $150,000.

Standardizing Electric Lamp Bulbs

In line with the prevailing policy of standardizing and simplifying products, the General Electric Company, makers of the Edison Mazda lamp, and the Westinghouse interests who manufacture the Westinghouse Mazda, have adopted as standard, five types of lamps in place of the forty-five types which have previously been made. By this means large savings are made in production, shipping and packing. One of the newly standardized types has already been placed on the market at considerably lower prices than those at which the old types were sold.

Starting a Library of Books on Glass

It was recently announced at Toledo, O., that a new section devoted to technical books on glass and glassmaking will be installed in the Public Library of that city. A beginning has been made with cash donations received from several concerns interested in glass, including: Libbey Glass Manufacturing Company, Buckeye Clay Pot Company, Owens Bottle Company, Edward Ford Plate Glass Company and Libbey-Owens Sheet Glass Company.

Bottle Blowers' Association Re-elects Officers

All of the officers of the Glass Bottle Blowers' Association were re-elected at the recent annual meeting, as follows: James Maloney, president; William Campbell, vice-president; Harry Jenkins, secretary, and Harry Halton, treasurer. The 1926 convention will be held at Buffalo, N. Y.

Trade Activities

The Murphy Glass Corporation, Hawley, Pa., has been incorporated by George W. Murphy with a capital of $25,000.

The Capstan Glass Company, Connellsville, Pa., announce an increase in their capital stock from $2,500,000 to $3,000,000.

The Chamber of Commerce, Kittanning, Pa., announces that negotiations are proceeding with out-of-town interests for the establishment of a glass plant at Kittanning.

The Giedroye Manufacturing Company, Vineland, N. J., has been incorporated with a capital of $100,000, by Sigmund A. Giedroye, Thaddeus B. Giedroye and Leon J. Allen. The firm, it is reported, will manufacture scientific glassware.

Hansen, Sommer & Maca, Inc., manufacturers of glass grinding, beveling, polishing and drilling machinery, 671 West Sixteenth St., Chicago, Ill., has awarded the contract for a new one-story factory with basement, 100 x 101 ft. to cost $45,000.

The Turner Brothers Company, Terre Haute, Ind., suffered damage by fire on July 16 when their bottle department was destroyed due to a broken oil line catching fire. The blaze was quickly controlled without serious loss, except to stock and machinery.

The Ford Motor Company, according to local newspaper statements, has let a contract to H. C. Struchen, St. Paul, Minn., for one unit of the proposed $4,000,000 addition to the present Ford plant in that city which, it is reported, will be devoted to glassmaking.

The Perfect Glass Company, it is reported, has been formed by Edward Jones, as president; A. J. Rowing, vice-president, and Henry Renard, general manager, to take over the plant of the Eureka Tumbler Company, Cameron, W. Va. The new company will produce table and stem ware.

The Upland Flint Glass Company, North Marion, Ind., had a fire on July 9, the principal damage being to the building housing the lehrs, fans and motors. The fire was prevented from reaching the main buildings. The plant has been closed down for repairs, which will include the rebuilding of the tank.

The Universal Glass Company's plant at Valley Park, Mo., which has been idle for a number of years was recently sold by order of the court to satisfy a $255,000 mortgage. Only a fraction of the original value of the plant was obtained at the sale. The factory and other property including dwelling houses, etc., was divided into parcels and sold by auction.

The Co-Operative Glass Company who, following the destruction of their plant by fire at North Vernon, Ind., last spring, established a new plant at Corydon, Ind., are now in active operation producing lamp chimneys. The factory is said to be working four shifts of four hours each, between 6 A. M. and 10. P. M.

The General Refractories Company, Philadelphia, Pa., at a recent meeting, elected Burrows Sloan to be president of the company, taking the place of former Governor William C. Sproul, who was made chairman of the board of directors. Mr. Sloan has been connected with the company since its organization in 1911, recently holding the office of senior vice-president.

The Dempsey Furnace Company, Jersey City, N. J., has been consolidated with the **W. N. Best Corporation,** 11 Broadway, New York, manufacturers of industrial oil-fired furnaces, oil burners, etc. The combined furnace business of the two companies will be operated as the Dempsey Furnace Division of the W. N. Best Corporation and will be under the direction of H. B. Dempsey.

The Puget Sound Glass Company, Anacortes, Wash., of which H. D. Jackson is president, recently became a member of the Washington Manufacturers' Association. The company's plant is reported to be producing bottles in quantities by automatic machinery. They recently increased their capital stock from $75,000 to $99,000 to provide for further expansion.

The Star Glass Company, Star City, W. Va., which has been operated by C. T. Herd and H. Kauffeld as receivers during the past year, is reported by Frank P. Weaver, commissioner in chancery, in a statement filed in the circuit court at Morgantown, W. Va., to have had total gross sales of $153,144 during the year, all but $4,586 of which had been collected. Expenses were $162,311, showing a deficit of $17,263.

The stock and good will of **H. A. Rogers Company,** New York, for the past 50 years sole agents for John Moncrieff, Ltd.,, Perth, Scotland, manufacturers of gauge glasses, has been sold to **Jenkins Bros.,** 80 White street, New York, and will be carried on under the direction of William A. Tucker, who was associated with the Rogers Company for over forty years. Jenkins Bros. will be in a position to serve the jobbers and dealers with gauge glasses from their various branches and warehouses in Boston, Philadelphia, Chicago and New York.

The Lippincott Glass Company receivership was lifted on July 17 and by order of the superior court of Indiana the receivers, S. G. Phillips and H. M. Adams, were discharged and the property of the company at Alexandria, Ind., returned to the corporation. Under the new arrangement the entire stock of the company has changed hands and the Lippincott family is no longer connected with it. The new owners are a group of Cincinnati men with Frank C. Terry, for 17 years vice-president and builder of the Icy Hot Bottle Company, as president of the Lippincott Glass Company; Henry C. Bentley, as secretary-treasurer, and H. M. Anderson as vice-presi-

dent-in-charge. The new owners and the company assume all the assets and liabilities of the receivership.

Personal Notes

George E. Zeiler for several years superintendent of the United States Glass Company's plant at Gas City, Ind., resigned his position on July 1. Mr. Zeiler will be succeeded by J. A. Jones.

F. H. Neipling, formerly with the Findlay Clay Pot Company, Washington, Pa., has become connected with the Buckeye Clay Pot Company, Toledo, O., and will represent them in the glass trade.

James Bryce, who for many years has been connected with United States Glass Company, Pittsburgh, Pa., resigned recently as superintendent of Factory F and has become connected with the Duncan & Miller Glass Company, Washington, Pa.

E. J. Verlie, for the past six months general attorney for the Illinois Glass Company, Alton, Ill., was appointed assistant secretary at a recent meeting of the directors of the company. Mr. Verlie will continue in the capacity of attorney in addition to filling his new office.

Newspaper reports from Moundsville, W. Va., announce that **A. C. Scroggins, Jr.,** has resigned as secretary and treasurer of the Fostoria Glass Company of that city. Mr. Scroggins started as office boy with the company in 1889 when it was located at Fostoria, O., going with the firm to Moundsville in 1892 when he was first given departmental work. In 1902 he was elected secretary and treasurer.

Industrial Publications

Glass Making Materials is the title of an attractively illustrated 24-page catalog issued by C. E. Ramsden & Company, Fenton, Stoke-on-Trent, England. The booklet contains a number of articles on raw materials and refractories used in the glass industry. Several typical glass batches are given. The catalog should be of interest to all glass manufacturers.

What Our Advertisers Are Doing

The Chapman-Stein Furnace Company, Mt. Vernon, O., are installing a new eight-pot Chapman-Stein recuperative furnace at the Yunck Glass Company, Orange, N. J., who are rebuilding that portion of their plant which was recently destroyed by fire. Oil will be used as fuel.

The Wellman-Seaver-Morgan Company, Columbus, O., have received an order through the Simplex Engineering Company, Washington, Pa., for the erection of a new gas producer plant at the Fostoria Glass Company, Moundsville, W. Va.

Coming Meetings

AMERICAN CERAMIC SOCIETY fall meeting will be held at New York City, October 1, 1925, and the annual meeting at Atlanta, Ga., February 8-13, 1926.

THE STAINED GLASS ASSOCIATION OF AMERICA, formerly the National Ornamental Glass Association, will hold its next annual convention in the summer of 1926 in Washington, D. C., which will be followed by a trip to Europe.

THE WESTERN DIVISION of the NATIONAL GLASS DISTRIBUTORS' ASSOCIATION will hold its fall meeting at Chicago, September 11 and 16. The Eastern branch of the association will hold its fall meeting at Atlantic City, the following week.

The annual convention of the AMERICAN BOTTLERS OF CARBONATED BEVERAGES will be held at Kansas City, Mo., October 19 to 23.

TENTH EXPOSITION OF CHEMICAL INDUSTRIES will be held at Grand Central Palace, New York, September 28 to October 3, under the management as usual of the International Exposition Company, 480 Lexington Ave., New York.

What the World Wants

Specific inquiries for American goods received in the Department of Commerce

Africa. 15791, cheap and medium priced glassware.
Perto Rico. 15897, window glass.
Mexico. 15904, glassware.
Haiti. 15910, low-priced glassware.

Inquiries Received

For Further Information Address THE GLASS INDUSTRY

277. (Japan.) We are interested in automatic equipment for making lamp chimneys on a large scale. (July 13.)
278. Please put us in touch with glass sand producers on the Atlantic Coast who are in a position to ship sand by water to California. (June 30.)
279. Can you give me the names of manufacturers or importers of a fine quality colored glass tubing? (July 18.)
280. Can you tell me who makes glass electric push button plates?

Glass Stock Quotations

Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Pa.

PITTSBURGH STOCK EXCHANGE, July 23, 1925.

	Bid	Ask	Last
American Window Glass Machine, com..	90	92	91
American Window Glass Machine, pfd...	95	98	95
American Window Glass, preferred.....	114	..	114
U. S. Glass	13	14	15
Pittsburgh Plate Glass	280	286	285
Standard Plate Glass, common.....	10¼	10½	10¼
Standard Plate Glass:			
Preferred cumulative	70	71	70
Prior	..	90	90

The glass stocks on the Pittsburgh Stock Exchange showed moderate activity during July. A decline in U. S. Glass during the month with some later recovery featured the trading. The good market condition which developed the last week in June has continued. Orders for window glass are coming in to manufacturers from all parts of the country in better volume than any month since January, which set a record for 1925.

Standard Plate Glass has been operating at capacity since early this year and present demand indicates that a high rate of production can be continued through the third quarter.

The first half of 1925 must be regarded as a period of business prosperity, measured by any standards that one may choose. Business profits were more satisfactory and the material comfort and buying power of our 115 million people was greater than at any time since 1919. In 1923, prosperity was confined, for the most part, to industrial workers. This year, the beneficial effect embraces practically all classes and is of especial benefit to the farmer.

What of the outlook for the last half of the year? A further enhancement of prosperity in the agricultural regions, and, therefore, a further increase in farm consumption of goods is indicated. Industrial production, which has been gradually declining for the past five months, should manifest a turn for the better the first of September. This restricted activity during the summer has laid an excellent foundation for good business during the latter half of the year. Firm and rising prices for the majority of manufacturers' raw materials, and for most classes of consumers' goods must be expected. Profits should approximate those for the first half of the year in most lines and conspicuously exceed those for the last half of 1924. Hardening interest rates in the fall will probably cause periods of sharp reaction in the speculative markets.

Automobile production, which reached its peak in April, will slowly recede. Price cuts and the introduction of new models may preclude the raising of dividend rates by the motor companies, although some extras would seem justified.

WHEELING STOCK EXCHANGE, July 23, 1925.

Hazel-Atlas	32	35	35
Imperial	..	72	72
Fostoria	140	..	150
Central	..	91	95

The Wheeling Glass market is strong, with general plant activity approximating 65 per cent. Hazel-Atlas, the largest plant in the district, is estimated to have earned $1,200,000 in the first half of 1925, against $900,000 in the full 12 months of 1924.

TOLEDO STOCK EXCHANGE, July 23, 1925.

Owens Bottle Machine, common.....	56	56¼	56
Libbey-Owens Sheet Glass, common.....	197	200	197
Libbey-Owens Sheet Glass, preferred.....	110	..	110

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers.

July 23, 1925		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.06	.07
Aluminum oxide (Al_2O_3)	lb.	..	..
Ammonium fluoride	lb.	..	.23
Antimony oxide (Sb_2O_3)	lb.	.18	.19
Antimony sulphide (Sb_2S_3)	lb.	..	.18
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04½	.05
Barium carbonate ($BaCO_3$)			
Precipitated	ton	..	..
Natural, powd.	ton	42.00	45.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05½
Bone ash	lb.	.05½	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04¾-.05	.05-.05¼
Borax, fused ($Na_2B_4O_7$) any mesh	lb.	..	.35
Boric acid (H_3BO_3)	lb.	..	.08½
Boric acid, refined	lb.	.09	.09½
Cadmium sulphide (CdS)—Red	lb.	..	1.20
Orange	lb.	..	1.20
Yellow	lb.	..	1.50
Caustic potash	lb.	..	.07¾
Chrome oxide (Cr_2O_3)	lb.	.30	.33
Citric acid	lb.	..	.48
Cobalt oxide (Co_2O_3)—			
In bbls	lb.	..	2.10-2.20
In 10 lb. tins	lb.	..	2.20
Copper oxide—			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6)	lb.	..	.09⅛
Feldspar—			
100 mesh	ton	12.00	16.00
Ferric oxide (Fe_2O_3)	ton	..	.02
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	..
Powdered white, 90%	ton	38.00	..
Hydrochloric acid, 20° (Carb. $5)	lb.	..	.02
Hydrofluoric acid (HF) 60% (in lead carboys)	lb.	..	.13-.13½
52% and 48%	lb.	..	.10-.11½
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, ex. vessel, gross ton		13.50	22.00
Powder, New York	ton	35.00	50.00
Lead oxide (Pb_3O_4) (red lead)	lb.	.11½	.11½
Litharge (PbO)	lb.	.11	.11
Lime—			
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl.		2.15	2.30
Magnesium carbonate ($MgCO_3$)	lb.	.03¼	.03½
Manganese 85% (MnO_2)	lb.	.03½	.03¾
Nickel oxide (Ni_2O_3), black, for nickel content	lb.	..	.35
Nickel monoxide (NiO), green, for nickel content	lb.	..	.35
Nitric acid (38°) (Carboy $5)	lb.	..	.06½
Potassium carbonate—			
Calcined (K_2CO_3) 96%	lb.	.06¾	.07
Hydrated 85%	lb.	.05¾	.06
Potassium nitrate (KNO_3) (gran.)	lb.	.06⅛	.06⅜
Potassium permanganate ($KMnO_4$)	lb.	.15	.16
Powdered blue	lb.	..	.24-.30
Rochelle salts	lb.	..	.20
Salt cake, glassmakers (Na_2SO_4), f.o.b. works, bulk	ton	21.00-22.00	.01½-.02 lb.
Selenium (Se) black, powd.	lb.	..	2.10
Red, powd.	lb.	..	1.95
Silver nitrate ($AgNO_3$) 100 oz., per oz.		..	.48½
Soda ash (Na_2CO_3) dense, 58%— f.o.b. works.			
Bulk, spot	Flat 100 lb.	1.35-1.40	..
Bulk, on contract	Flat 100 lb.	1.35	..
In 400 lb. bbls., on contract	100 lb.	1.69	2.40
In 400 lb. bags, on contract	100 lb.	1.45	..
Spot orders .05 per 100 lbs. higher.			
Sodium nitrate ($NaNO_3$),			
Refined (gran.) in bbls	lb.	.03¾	.04
95%	lb.	.02½	.02¼
Sodium selenite (Na_2SeO_3)	lb.	..	2.35-2.40
Sodium fluosilicate (Na_2SiF_6)	lb.	..	.04¾
Sodium uranate (Na_2UO_4)	lb.	..	1.45
Sulphur (S)—			
Flowers, 155 lb. bbl.	Per 100 lb.	3.35-3.65	3.75-3.90
Flowers, in bags	Per 100 lb.	3.00-3.30	3.40-3.55
Flour, heavy, in bbls.	Per 100 lb.	2.50-2.80	2.90-3.05
Tartaric acid	lb.	..	.29
Tin oxide (SnO_2) in bbls	lb.	..	.60
Uranium oxide (UO_3), 100 lb. lots	lb.	..	1.15
Zinc oxide (ZnO)	lb.	.07¼	.07¾

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to June 24, 1925.

	May 1924 Quantity	May 1924 Value	May 1925 Quantity	May 1925 Value	Eleven Months Ending May 1924 Quantity	Eleven Months Ending May 1924 Value	Eleven Months Ending May 1925 Quantity	Eleven Months Ending May 1925 Value
Glass and glass products (total)	.....	$803,487	.....	$901,198	.....	$9,067,615	.....	$7,918,290
Plate and window glass—								
Window glass, common, box 50 sq. ft.	6,119	24,741	2,162	14,349	46,674	207,573	31,259	161,332
Plate glass, unsilvered, sq. ft.	172,923	41,759	212,682	49,376	1,511,454	564,103	1,422,447	386,681
Other window and plate glass, n.e.s. lbs.	88,905	14,727	216,781	21,713	2,102,409	236,594	1,874,940	196,422
Glass containers (bottles, vials and jars) lbs.	5,766,542	302,831	8,300,785	344,990	59,095,804	2,874,350	61,476,808	2,741,288
Table glassware, plain lbs.	1,166,868	145,728	1,576,464	168,117	16,820,021	1,891,828	15,823,374	1,619,942
Table and other glassware, cut or engraved lbs.	45,452	15,628	58,528	18,601	483,083	158,991	544,397	159,035
Glassware for lighting—								
Lamp chimneys and lantern globes lbs.	198,177	34,282	196,681	36,230	1,842,400	348,532	1,798,693	312,414
Globes and shades for lighting fixtures lbs	104,443	44,661	113,243	41,596	1,518,448	435,377	1,354,977	393,807
Lamps and other illuminating devices, chiefly of glass lbs.	72,714	15,390	41,675	12,205	1,273,079	326,850	793,577	229,263
Chemical glassware lbs.	16,537	14,162	17,945	13,438	231,105	166,485	231,512	180,436
Electrical glassware, except for lighting lbs.	196,490	17,134	516,169	37,503	2,359,512	195,687	2,388,885	224,147
Other glassware, n.e.s. lbs.	611,095	132,444	794,880	143,080	10,253,128	1,661,245	6,495,236	1,313,523

IMPORTS

Corrected to June 24, 1925.

Glass (total)	.....	$1,993,276	.....	$1,435,428	.....	$22,462,869	.....	$15,844,739
Cylinder, crown and sheet—								
Unpolished, lbs. dut.	2,905,990	157,135	2,821,798	152,624	32,142,349	1,678,651	38,006,526	2,047,816
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	36,312	.....	41,702	.....	655,835	.....	487,199
Plate glass—								
Unsilvered, sq. ft. dut.	2,011,356	1,287,387	1,524,361	749,653	23,025,585	14,751,593	13,457,299	6,816,499
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut.	278,904	35,689	60,359	10,140	2,246,180	325,412	1,519,230	244,734
Containers—bottles, vials, etc. dut.	.....	28,688	.....	12,931	.....	176,789	.....	159,394
Table and kitchen utensils, lbs. dut.	58,782	14,907	35,895	8,968	747,482	160,415	521,260	131,158
Glassware, cut or decorated, lbs. dut.	314,329	133,742	317,062	164,555	3,391,784	1,507,778	3,783,900	1,943,460
Blown glassware, n. e. s., lbs. dut.	.....	.....	.....	.....	[3]3,402,894	[3]881,319	.....	.....
Bottles, ornaments, etc., lbs. dut.	242,314	81,359	208,448	81,137	[2]1,162,405	[2]413,167	5,421,058	1,551,451
Bulbs or electric lamps, number dut.	2,192,195	28,562	2,531,301	24,732	[2]5,562,781	[2]77,806	17,689,666	194,337
Chimneys, globes, shades, etc., lbs. dut.	498,959	85,335	421,752	91,503	[2]1,894,702	[2]308,128	4,728,599	1,056,081
Articles and utensils for chemical, scientific, and experimental purposes, lbs. dut.	146,461	36,140	56,983	18,824	[2]392,165	[2]135,060	807,932	283,274
Other glassware dut.	.....	68,020	.....	78,659	.....	1,390,916	.....	929,336

[1] July 1, to Dec. 31, 1923. [2] Beginning Jan. 1, 1924.

No. 8

½
¾

½

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.30

.02 lb.

½

¼
2.40
¼

3.90
3.55
3.05

¼

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290
332
681
422
288
942
035
414
807
263
436
147
523
739
816
199
999
734
494
158
860
51
37
81
274
36